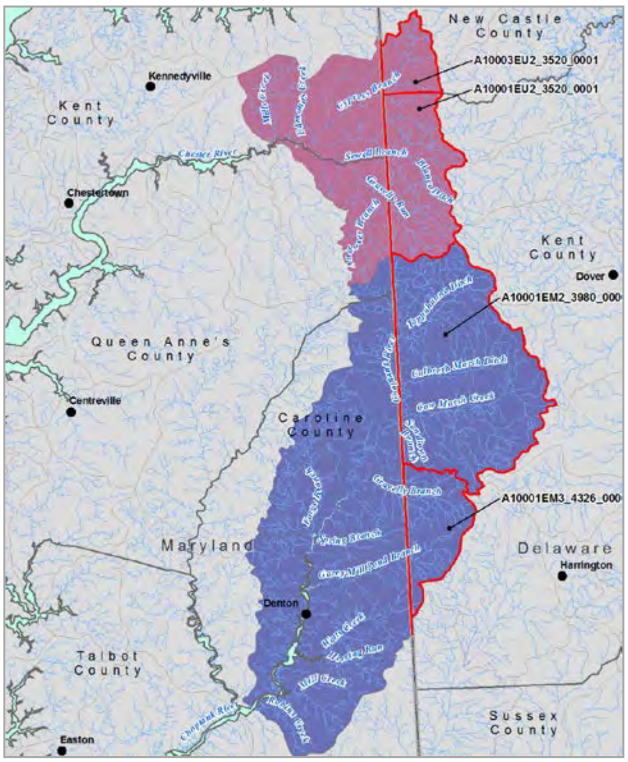
Chester River and Choptank River Watershed Management Plan

Final Plan

November 2014



Prepared for:

Department of Natural Resources and Environmental Control (DNREC)

Prepared by:

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KCI TECHNOLOGIES

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KCI Job Order No. 17133560

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List of Acronyms

BMP	Best Management Practices
CAFO	Concentrated Animal Feeding Operations
CAST	Chesapeake Assessment Scenario Tool
CBP	Chesapeake Bay Program
DNREC	Department of Natural Resources and Environmental Control
USEPA	United States Environmental Protection Agency
MS4	Municipal Separate Storm Sewer System
NMP	Nutrient Management Plan
NPDES	National Pollutant Discharge Elimination System
OWTDS	Onsite Wastewater Treatment and Disposal System
SWM	Stormwater Management
TMDL	Total Maximum Daily Load
TN	Total Nitrogen
TP	Total Phosphorus
TSS	Total Suspended Solids
WIP	Watershed Implementation Plan
WSM	Chesapeake Bay Watershed Model
WWTP	Wastewater Treatment Plant

List of Appendices

1 Introduction

The Delaware Department of Natural Resources and Environmental Control (DNREC) Division of Watershed Stewardship is developing Watershed Plans to describe the conditions of major watersheds across the State and to present restoration measures aimed at meeting DNREC's watershed management goals, specifically for this current planning effort, meeting the goals associated with Total Maximum Daily Loads (TMDL). Across the Delaware portion of the Chesapeake Bay watershed, TMDLs are in place related to both Bay-wide and local impairments. In 2010 and 2012, the State of Delaware completed Phase I and Phase II Watershed Implementation Plans (WIP) for the Chesapeake Bay in response to requirements for meeting the Chesapeake Bay Total Maximum Daily Load (TMDL) for nitrogen, phosphorus, and sediment. The *Upper Chesapeake Watershed Tributary Action Team Pollution Control Strategy Recommendations* is a comprehensive study and management plan that is currently in place for the local impairments and associated TMDLs in the Chester and Choptank Rivers (DNREC, 2008 – refer to Appendix C).

This current planning effort is designed to forward the recommendations provided in the WIPs, with greater specificity for smaller planning units, including local TMDLs, while incorporating existing data and planning efforts. The Watershed Plans will target local TMDL reductions, where applicable, and Bay TMDL reductions where local TMDLs are not currently in effect. As the WIPs are the program the State of Delaware is implementing, it will be applied to both Bay and local TMDLs. Planning units with nutrient local TMDLs will use the same planning methods and process as the Bay TMDL including unit scale, land use data, and modeling. As the effort is focused on the Chesapeake Bay, the plans include Delaware's Bay watersheds which have been grouped into the following four planning units.

- Upper Chesapeake, which includes the Elk River, C&D Canal, Bohemia Creek, and the Sassafras River;
- Chester River and Choptank River;
- Nanticoke River, which includes three major tributaries, Gum Branch, Gravelly Branch, and Deep Creek; and
- Pocomoke River and Wicomico River.

Information synthesized and incorporated into this plan for the Chester River and Choptank River Watersheds is pulled from several resources. The primary sources are:

- Delaware's Phase I Chesapeake Bay Watershed Implementation Plan – November 29, 2010, prepared by Delaware's Chesapeake Interagency Workgroup (DCIW, 2010)
- Delaware's Phase II Chesapeake Bay Watershed Implementation Plan – March 30, 2012, prepared by Delaware's Chesapeake Interagency Workgroup (DCIW, 2012)
- Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorous, and Sediment – December 2010 (USEPA, 2010a)
- Code 7412 TMDLs for the Chester River Watershed in Delaware – January 2006 (State of Delaware, 2006a)
- Code 7413 TMDLs for the Choptank River Watershed in Delaware – January 2006 (State of Delaware, 2006b)
- Total Maximum Daily Loads (TMDLs) Analysis for Chesapeake Drainage Watersheds, Delaware: Chester River, Choptank River, and Marshyhope Creek. Watershed Assessment Section, Division

of Water Resources, Delaware Department of Natural Resources and Environmental Control (DNREC. 2005)
- Code 7430 TMDLs for Bacteria for the Chesapeake Bay Drainage Basin, Delaware – December 2006 (State of Delaware, 2006c)
- Total Maximum Daily Loads (TMDLs) Analysis for Chesapeake Bay Drainage Basin, Delaware: Chester River, Choptank River, Marshyhope Creek, Nanticoke River, Gum Branch, Gravelly Branch, Deep Creek, Broad Creek, and Pocomoke River Watersheds - September 2006 (DNREC, 2006)
- Upper Chesapeake Watershed (Chester and Choptank River Watersheds) Tributary Action Team Pollution Control Strategy Recommendations – January 31, 2008 (DNREC, 2008)

Both the Chester River and Choptank River watersheds currently have a local TMDL for nitrogen and phosphorus (DNREC, 2005; State of Delaware, 2006a, State of Delaware, 2006b) and are also included in the 2006 bacteria TMDL for the Chesapeake Bay Drainage Basin (DNREC, 2006; State of Delaware, 2006c) and the 2010 Chesapeake Bay TMDL for sediments (USEPA, 2010a). Therefore, nutrient targets presented for the Chester and Choptank will be based on the local TMDL, bacteria targets will be based on the Chesapeake Bay Drainage Basin TMDL, and sediment targets will be based on the Bay TMDL (Table 1).

Table 1: TMDLs used for Pollutant Targets for Chester River and Choptank River Watersheds

Watershed	Nitrogen	Phosphorus	Sediment	Bacteria
Chester	Local TMDL	Local TMDL	Bay TMDL	Chesapeake Bay Drainage Basin TMDL
Choptank	Local TMDL	Local TMDL	Bay TMDL	Chesapeake Bay Drainage Basin TMDL

Sources:
1) Bay TMDL (USEPA, 2010a)
2) Chesapeake Bay Drainage Basin TMDL (DNREC, 2006)
3) Local TMDL (DNREC, 2005)

1.1 Goals and Objectives

The primary goal is to prepare the Chester and Choptank Plan in accordance with the United States Environmental Protection Agency's (EPA) nine essential elements for watershed planning. These elements, commonly called the 'a through i criteria' are important for the creation of thorough, robust, and meaningful watershed plans and incorporation of these elements is of particular importance when seeking implementation funding. The EPA has clearly stated that to ensure that Section 319 (the EPA Nonpoint Source Management Program) funded projects make progress towards restoring waters impaired by nonpoint source pollution, watershed-based plans that are developed or implemented with Section 319 funds to address 303(d)-listed waters must include at least the nine elements.

The Chester and Choptank Plan is organized based on these elements, which include:

a. An identification of the causes and sources that will need to be controlled to achieve the load reductions estimated in the plan and to achieve any other watershed goals identified in the plan, as discussed in item (b) immediately below.

b. An estimate of the load reductions expected for the management measures described under paragraph (c) below, recognizing the natural variability and the difficulty in precisely predicting the performance of management measures over time.

c. A description of the management measures that will need to be implemented to achieve the load reductions estimated under paragraph (b) above as well as to achieve other watershed goals identified in the plan, and an identification of the critical areas in which those measures will be needed to implement this plan.

d. An estimate of the amount of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon, to implement this plan.

e. An information/education component that will be used to enhance public understanding of the project and encourage their early and continued participation in selecting, designing, and implementing the recommended management measures.

f. A schedule for implementing the management measures identified in this plan that is reasonably expeditious.

g. A description of interim, measurable milestones for determining whether management measures or other control actions are being implemented.

h. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made towards attaining water quality standards and, if not, the criteria for determining whether the plan needs to be revised.

i. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under item (h) immediately above.

The outcomes of the planning effort are to provide guidance for the strategic implementation of watershed protection and restoration efforts that will advance progress toward meeting Delaware's local TMDLs and Bay TMDL pollutant loading allocations, and ultimately meeting water quality standards. Successful implementation of the plan will lead to improvements in local and Bay-wide watershed conditions and aquatic health.

1.2 Regulatory and Programmatic Environment

While many varied regulatory and volunteer programs exist to enforce environmental protection, the primary programs and regulations addressed by this plan are the Delaware local TMDLs, Chesapeake Bay TMDL, and the National Pollutant Discharge Elimination System (NPDES) permit. Under the Federal Clean Water Act (CWA), the state of Delaware is required to assess and report on the quality of waters throughout the state. Where Delaware's water quality standards are not fully met, Section 303(d) requires the state to list these water bodies as impaired waters. States are then required to develop a TMDL for pollutants of concern for the listed impaired waters. Delaware's TMDLs will be referred to as local TMDLs in this Watershed Management Plan. The *Chesapeake Bay Total Maximum Daily Loads for Nitrogen, Phosphorus, and Sediment* (USEPA, 2010a), is a result of requirements under the Clean Water Act to meet water quality standards and executive order 13508 sign by President Barack Obama in 2009 that put a renewed emphasis and focus on the Chesapeake Bay.

As a result of the renewed effort, and to ensure that progress is achieved, an accountability framework was implemented with actions that the EPA could take if Bay states did not show satisfactory progress. The first two elements of the framework included the development of Watershed Implementation Plans and two-year milestones that would identify specific targets and schedules. A third element linked the Bay TMDL to the NPDES program by calling for inclusion of meeting wasteload allocations within the NPDES permit.

Both the Chester River and Choptank River watersheds currently have a local TMDL for nitrogen and phosphorus (DNREC, 2005) and are also included in the 2006 bacteria TMDL for the Chesapeake Bay Drainage Basin (DNREC, 2006) and the 2010 Chesapeake Bay TMDL for sediments (USEPA, 2010a). Therefore, nutrient targets presented for the Chester and Choptank will be based on the local TMDL, bacteria targets will be based on the Chesapeake Bay Drainage Basin TMDL, and sediment targets will be based on the Bay TMDL.

1.3 Watershed Priorities

Priorities are discussed in more detail in Section 8.3: Implementation Priorities. Critical watershed issues including current 303(d) listings for biology and habitat and active nutrient TMDLs should all be considered priority areas for project implementation in the Chester and Choptank watersheds. Highest priority should be given to impaired segments located in headwaters. Impairments to headwater streams are carried and experienced downstream; therefore, improvements made to headwater streams will maximize the length of implementation impacts.

Current 303(d) impairments located in the Chester and Choptank watersheds are discussed in Section 2.4.2 and active TMDLs are discussed in Section 2.4.3. Chester River stream segments that should be prioritized include the mainstem and tributaries of Cypress Branch, Sewell Branch, and Gravelly Run while the mainstem and tributaries of Tappahanna Ditch, Culbreth Marsh Ditch, and Cow Marsh Creek should be prioritized for the Choptank River.

In addition to Chester/Choptank 303(d) listings, the Upper Chesapeake Watershed (Chester and Choptank River Watersheds) Tributary Action Team Pollution Control Strategy Recommendations – January 31, 2008 (DNREC, 2008) is a valuable resource which should be used as guidance for implementation efforts and is included as Appendix C of this plan.

2 Watershed Characteristics

2.1 Watershed Delineation and Planning Segments

Delaware lies on the Eastern shore of the Chesapeake Bay, with Bay drainage originating from each of Delaware's three Counties and including land located entirely within the Atlantic Coastal Plain Physiographic Province. The Upper Chester River and Upper Choptank River make up two of Delaware's 11 303(d) modeled segments and four of the 26 land river segments, which is the primary planning unit for modeling and accounting being used by the EPA (Figure 1 and Figure 2). The Upper Chester River is a part of the Upper Eastern Shore Basin, while the Upper Choptank River makes up the Middle Eastern Shore Basin.

Major Basin	Minor Basin	303(d) Segment	Land River Segment	County
Eastern Shore of Chesapeake Bay	Upper Eastern Shore	Elk River (ELKOH)	A10003EU1_2981_0000	NEW CASTLE
			A10003EU1_2983_0000	NEW CASTLE
		C&D Canal (C&DOH_MD)	A10003EU0_3010_0000	NEW CASTLE
		C&D Canal (C&DOH_DE)	A10003EU0_3011_0000	NEW CASTLE
		Bohemia River (BOHOH)	A10003EU0_3201_0000	NEW CASTLE
		Sassafras River (SASOH)	A10003EU0_3361_0000	NEW CASTLE
		Upper Chester River (CHSTF)	A10003EU2_3520_0001	NEW CASTLE
			A10001EU2_3520_0001	KENT
	Middle Eastern Shore	Upper Choptank River (CHOTF)	A10001EM2_3980_0001	KENT
			A10001EM3_4326_0000	KENT
	Lower Eastern Shore	Middle Nanticoke River (NANOH)	A10001EL2_4400_4590	KENT
			A10001EL2_4590_0001	KENT
			A10005EL2_4590_0001	SUSSEX
			A10005EL0_4591_0000	SUSSEX
			A10005EL0_4594_0000	SUSSEX
			A10005EL0_4597_0000	SUSSEX
		Upper Nanticoke River (NANTF_DE)	A10001EL0_4560_4562	KENT
			A10005EL0_4560_4562	SUSSEX
			A10005EL0_4561_4562	SUSSEX
			A10005EL0_4562_0001	SUSSEX
			A10005EL0_4631_0000	SUSSEX
			A10005EL0_4632_0000	SUSSEX
			A10005EL0_4633_0000	SUSSEX
			A10005EL2_4630_0000	SUSSEX
		Pocomoke River (POCTF)	A10005EL2_5110_5270	SUSSEX
		Wicomico River (WICMH)	A10005EL0_5400_0001	SUSSEX

Figure 1: Delaware Drainage Basins and Land River Segments (DCIW, 2012)

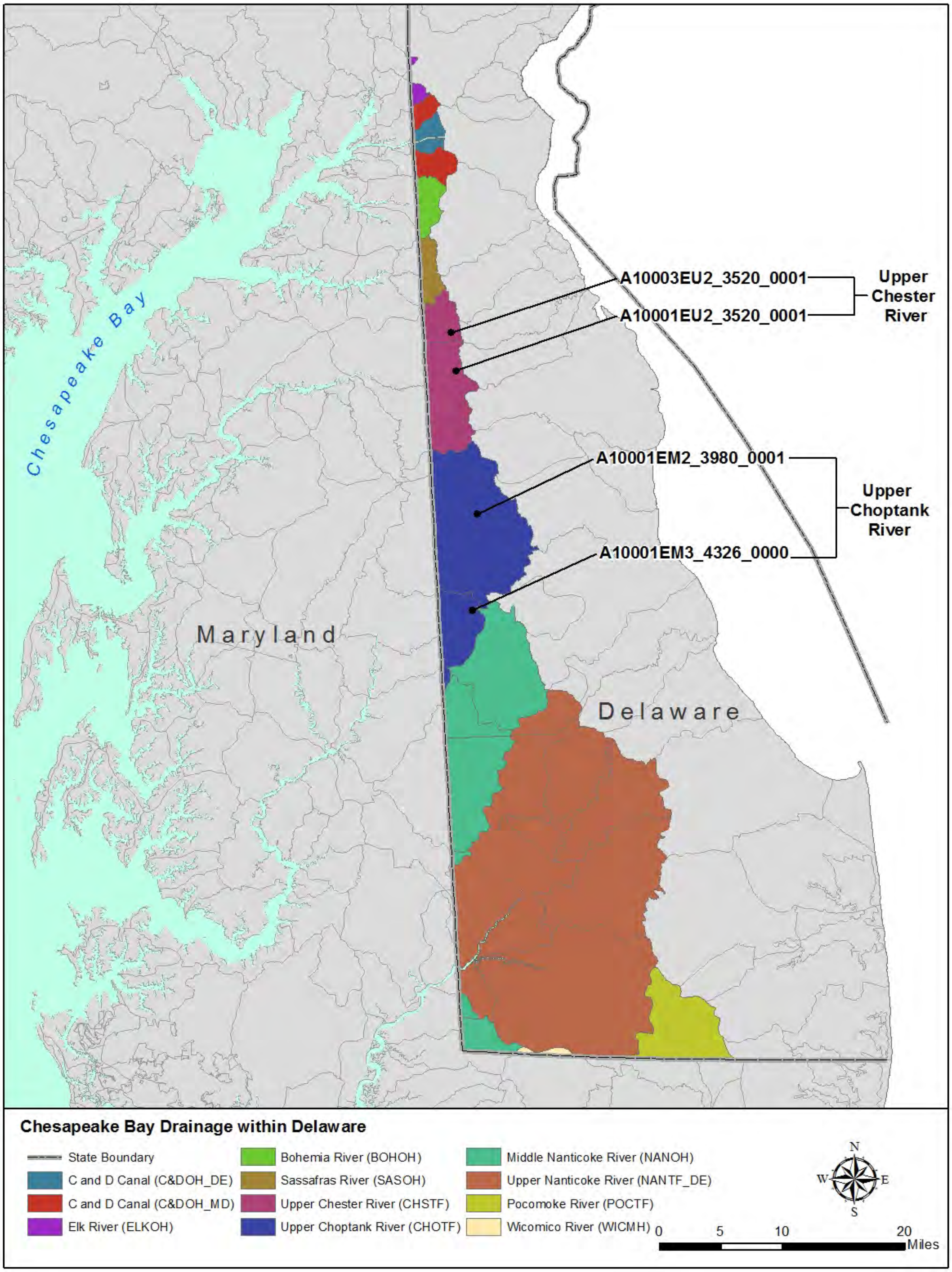


Figure 2: Delaware Chesapeake Bay Drainage and Chester and Choptank Planning Unit

2.2 Chester and Choptank

The Chester and Choptank planning unit used in this current plan includes the Upper Chester and Upper Choptank Rivers, the majority of which originate in Kent County, Delaware, while a portion of the Chester River originates in New Castle County, Delaware. Both rivers drain to the west into Maryland's eastern shore, including Kent County, Queen Anne's County, and Caroline County. The Chester and Choptank include 88,217.5 acres or 137.8 square miles of land area (Table 2). Figure 3 shows the location of each of the segments within the Chester and Choptank Planning unit, and each is described here.

2.2.1 Chester River

Chester River in Delaware includes a 40.0 square mile drainage area with headwaters beginning at the divide between New Castle and Kent Counties. Delaware headwater segments, including Cypress Branch, Sewell Branch, and Gravelly Run, flow west into both Kent County and Queen Anne's County, Maryland.

2.2.2 Choptank River

The Choptank River, located immediately south of Chester River, includes 62,619.5 acres, or 97.8 square miles of headwater in Delaware. The Choptank flows west into Maryland with the majority of the watershed located in both Kent County, Delaware and Caroline County, Maryland and a small, northern portion in Queen Anne's County, Maryland. Headwater tributaries to the Choptank River include Tappahanna Ditch, Culbreth Marsh Ditch, and Cow Marsh Creek.

Table 2: Chester and Choptank Watershed Drainage Area and Stream Miles

Watershed	Drainage Area (Acres)	Drainage Area (Square Miles)	Stream Miles
Chester River	25,598.0	40.0	104.2
Choptank River	62,619.5	97.8	343.0
TOTAL	**88,217.5**	**137.8**	**447.2**

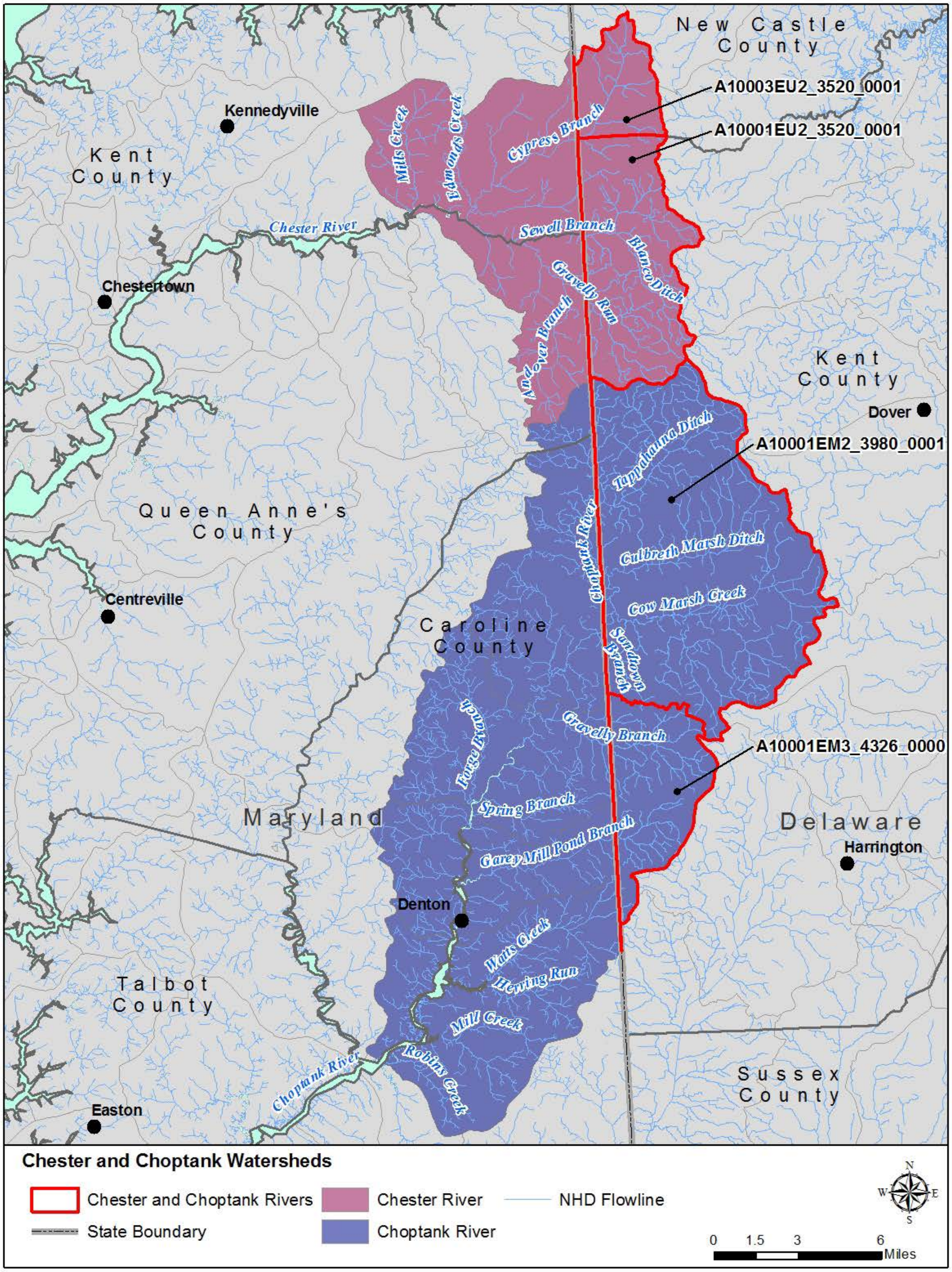


Figure 3: Chester and Choptank Planning Unit Watershed Locations

2.3 Land Use

The type and density of various land uses can have a dramatic effect on water quality and stream habitat. Forested areas slow stormwater flow and allow water to gradually seep into soils and drain into streams. Vegetation and soils bind nutrients and pollutants found within stormwater—improving water quality as it infiltrates the ground. Developed areas, with a high percentage of impervious surfaces (buildings, paved roads, parking lots, etc.), do not slow stormwater flow—increasing the amount of pollutants entering streams. Increased stormflow can negatively affect stream habitat by increasing bank erosion and decreasing instream and riparian habitat. Agricultural land, if managed incorrectly, can also increase nutrients and bacteria in streams.

See Figure 4, Figure 6, Figure 8, and Figure 10, for aerial imagery of each subwatershed. 2007 land use data from the Delaware Office of State Planning Coordination (2008) and 2007 impervious surface data from the State of Delaware, Office of Management and Budget (2008) are presented in Figure 5, Figure 7, Figure 9, and Figure 11. Land use data presented in the figures below were used to show potential sources and were not used in calculations.

2.3.1 Existing Land Use

The Chester and Choptank as a whole is made up of a mixture of land use, primarily including agriculture and forested lands (Table 3). Approximately one-half of the Chester and Choptank is forest (49.6%) with the remaining land use largely comprised of agriculture (43.6%). Less than ten percent of the watersheds consist of developed land (6.8%). Water makes up the small remainder (0.1%). Information presented in the table below is from the Chesapeake Bay Program (CBP) 2010 land use dataset.

Table 3: 2010 Chester and Choptank Land Use

Watershed	Land Use Description							
	Agriculture		Developed		Forest		Water	
	Acres	%	Acres	%	Acres	%	Acres	%
Chester River	9,843.5	38.5	1,621.4	6.3	14,113.1	55.1	20.0	0.1
Choptank River	28,591.0	45.7	4,342.9	6.9	29,619.1	47.3	66.5	0.1
Total	**38,434.4**	**43.6**	**5,964.3**	**6.8**	**43,732.2**	**49.6**	**86.5**	**0.1**

2.3.2 Imperviousness

Impervious surfaces concentrate stormwater runoff, accelerating flow rates and directing stormwater to the receiving stream. This accelerated, concentrated runoff can cause stream erosion and habitat degradation. Runoff from impervious surfaces picks up and washes off pollutants and is usually more polluted than runoff generated from pervious areas. In general, undeveloped watersheds with small amounts of impervious cover are more likely to have better water quality in local streams than urbanized watersheds with greater amounts of impervious cover. Impervious cover is a primary factor when determining pollutant characteristics and loadings in stormwater runoff.

The degree of imperviousness in a watershed also affects aquatic life. There is a strong relationship between watershed impervious cover and the decline of a suite of stream indicators. As imperviousness increases the potential stream quality decreases with most research suggesting that stream quality begins to decline at or around 10 percent imperviousness (Schueler, 1994; CWP, 2003). However, there is considerable variability in the response of stream indicators to impervious cover observed from 5 to

20 percent imperviousness due to historical effects, watershed management, riparian width and vegetative protection, co-occurrence of stressors, and natural biological variation. Because of this variability, one cannot conclude that streams draining low impervious cover will automatically have good habitat conditions and a high quality aquatic life.

Impervious surfaces make up just 1.6% of the overall Chester and Choptank drainage. See Figure 5, Figure 7, Figure 9, and Figure 11 for mapped impervious surfaces. Impervious surface is highest in Choptank River, specifically in the land river segment just west of Dover (1.7%). Additional Delaware drainage from the Choptank includes only 0.3% impervious surface. Both land river segments in Chester River (Sewell Branch and Cypress Branch) are very similar and make up 0.6% and 0.2%, respectively.

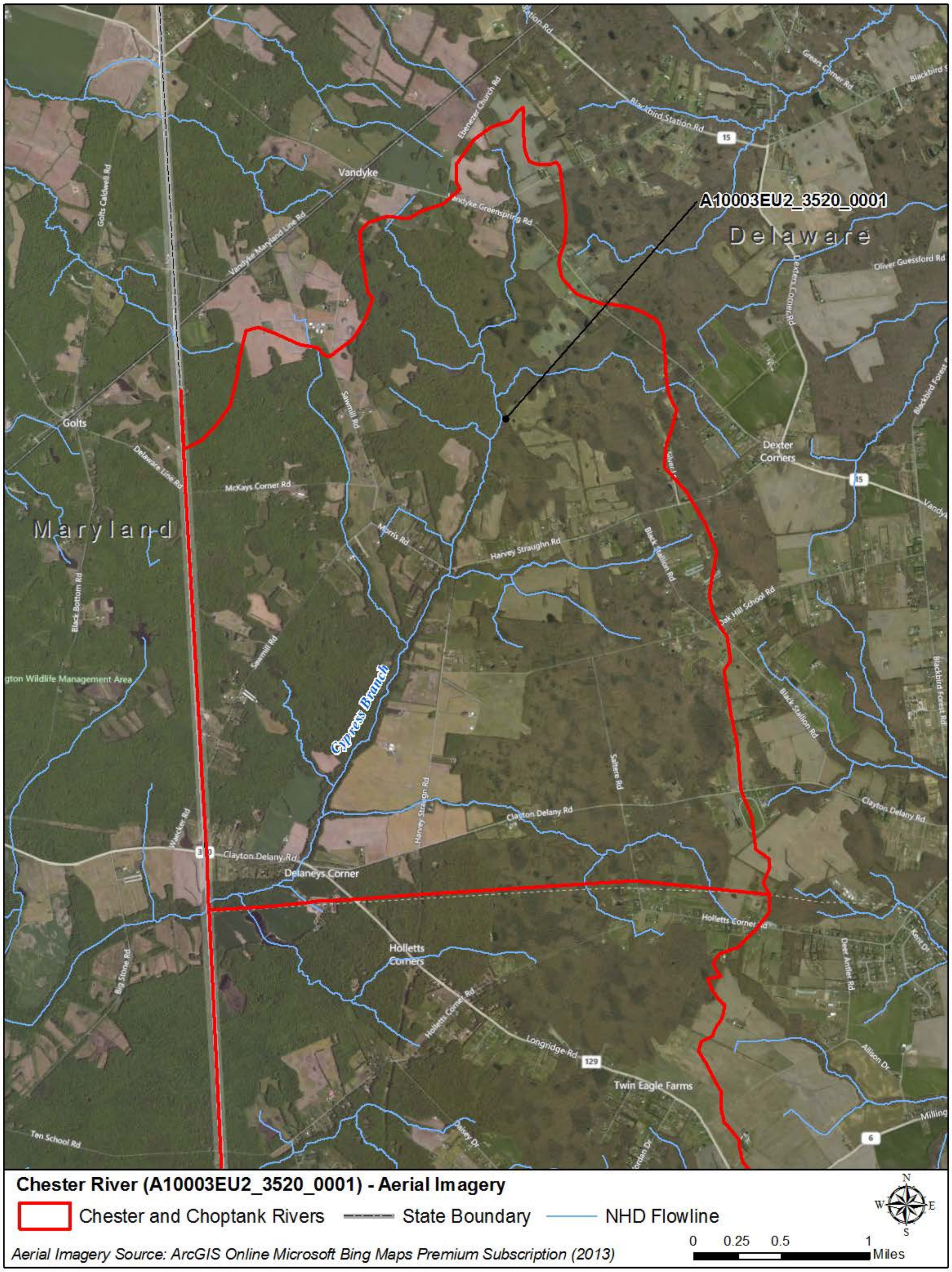


Figure 4: Chester River (A10003EU2_3520_0001) Aerial Imagery

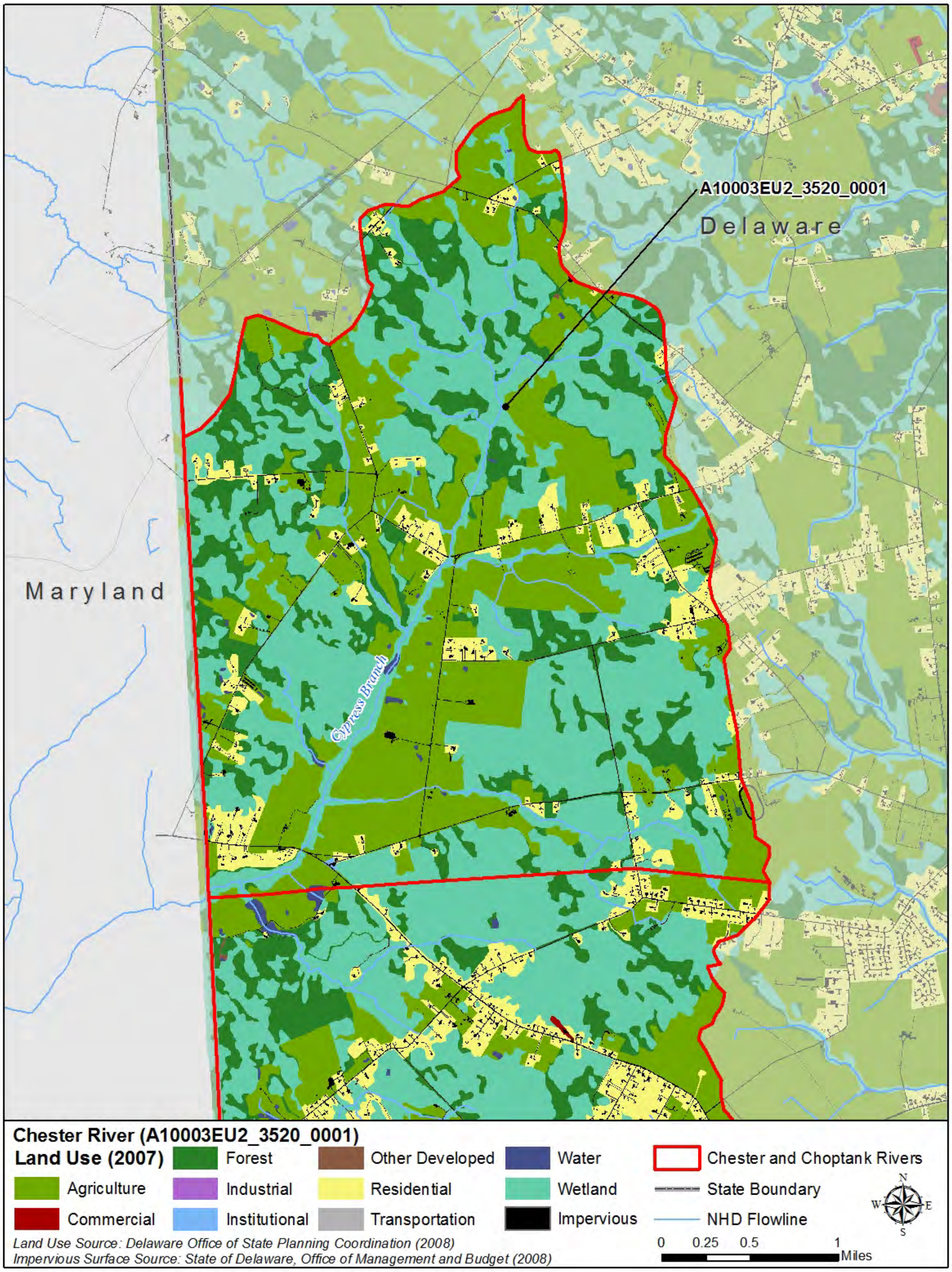


Figure 5: Chester River (A10003EU2_3520_0001) Land Use and Impervious Surface

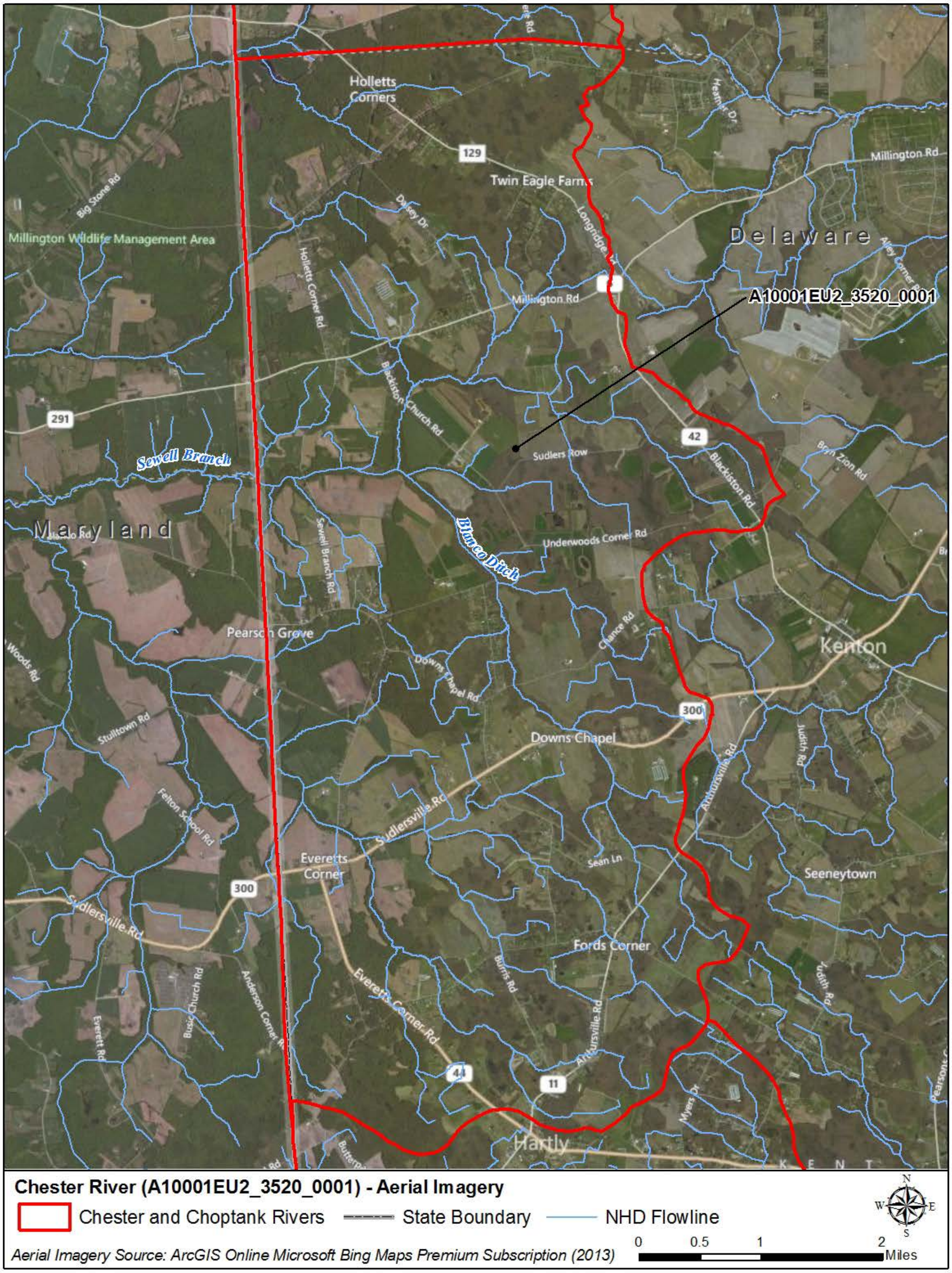


Figure 6: Chester River (A10001EU2_3520_0001) Aerial Imagery

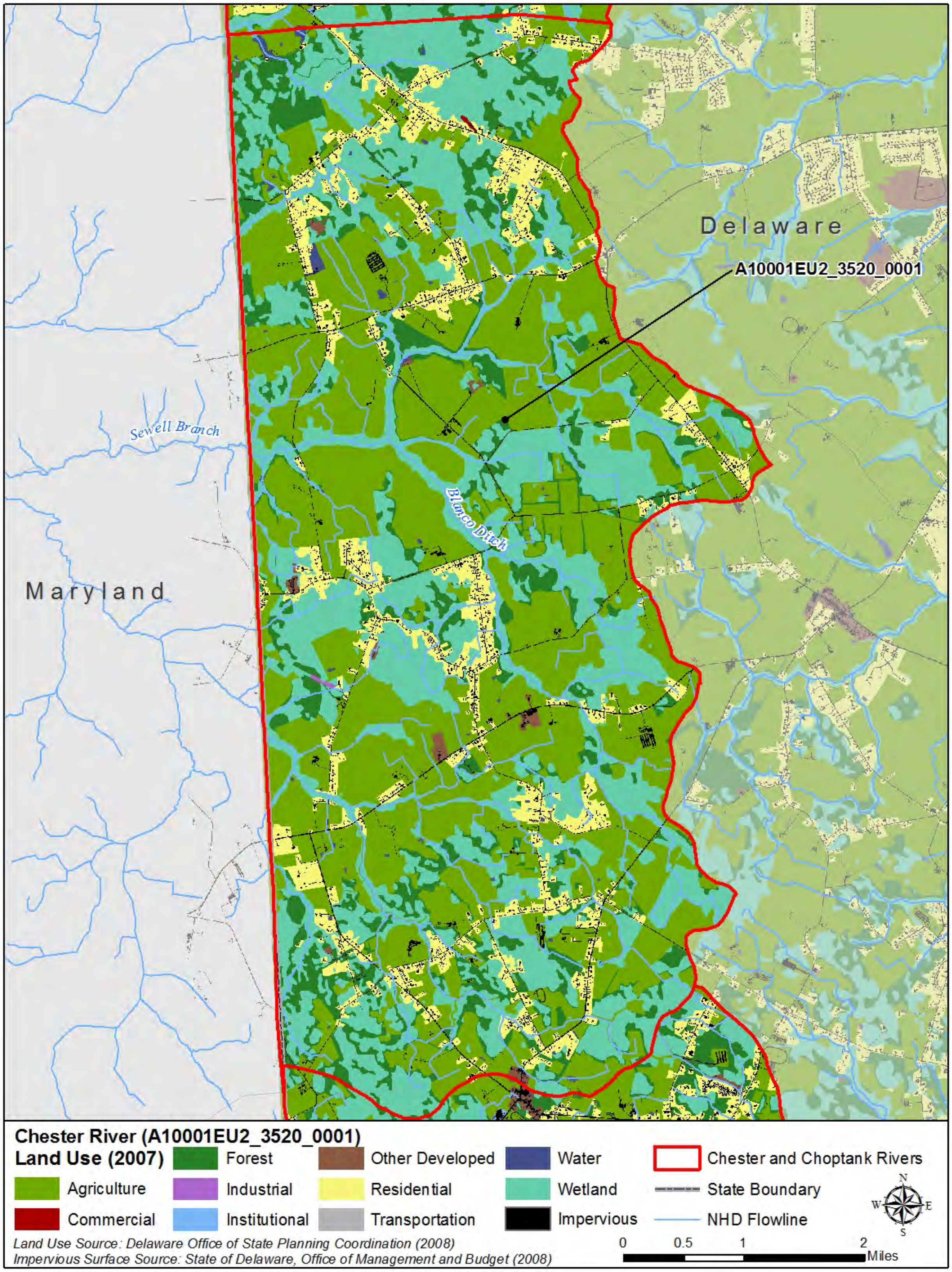


Figure 7: Chester River (A10001EU2_3520_0001) Land Use and Impervious Surface

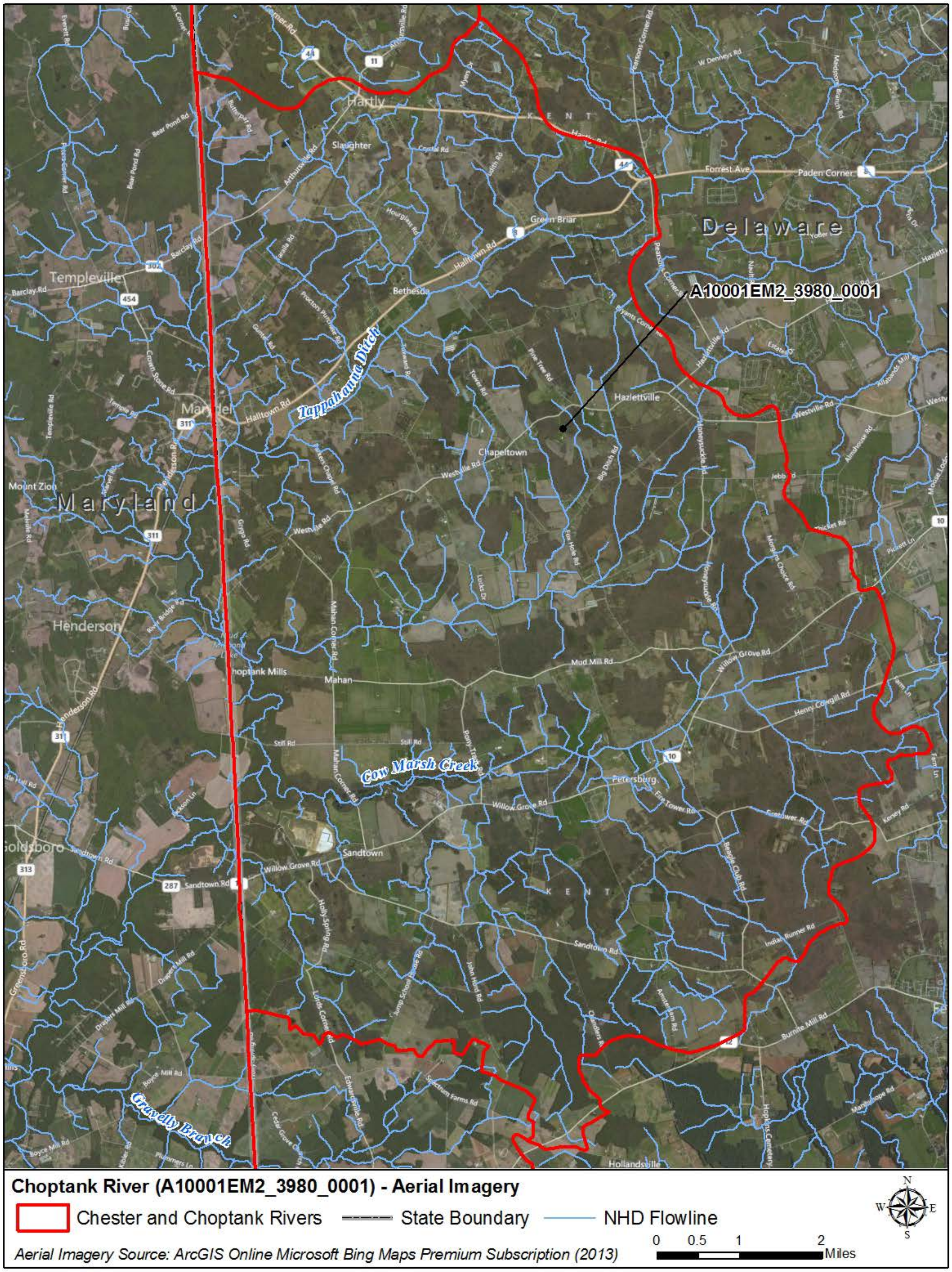


Figure 8: Choptank River (A10001EM2_3980_0001) Aerial Imagery

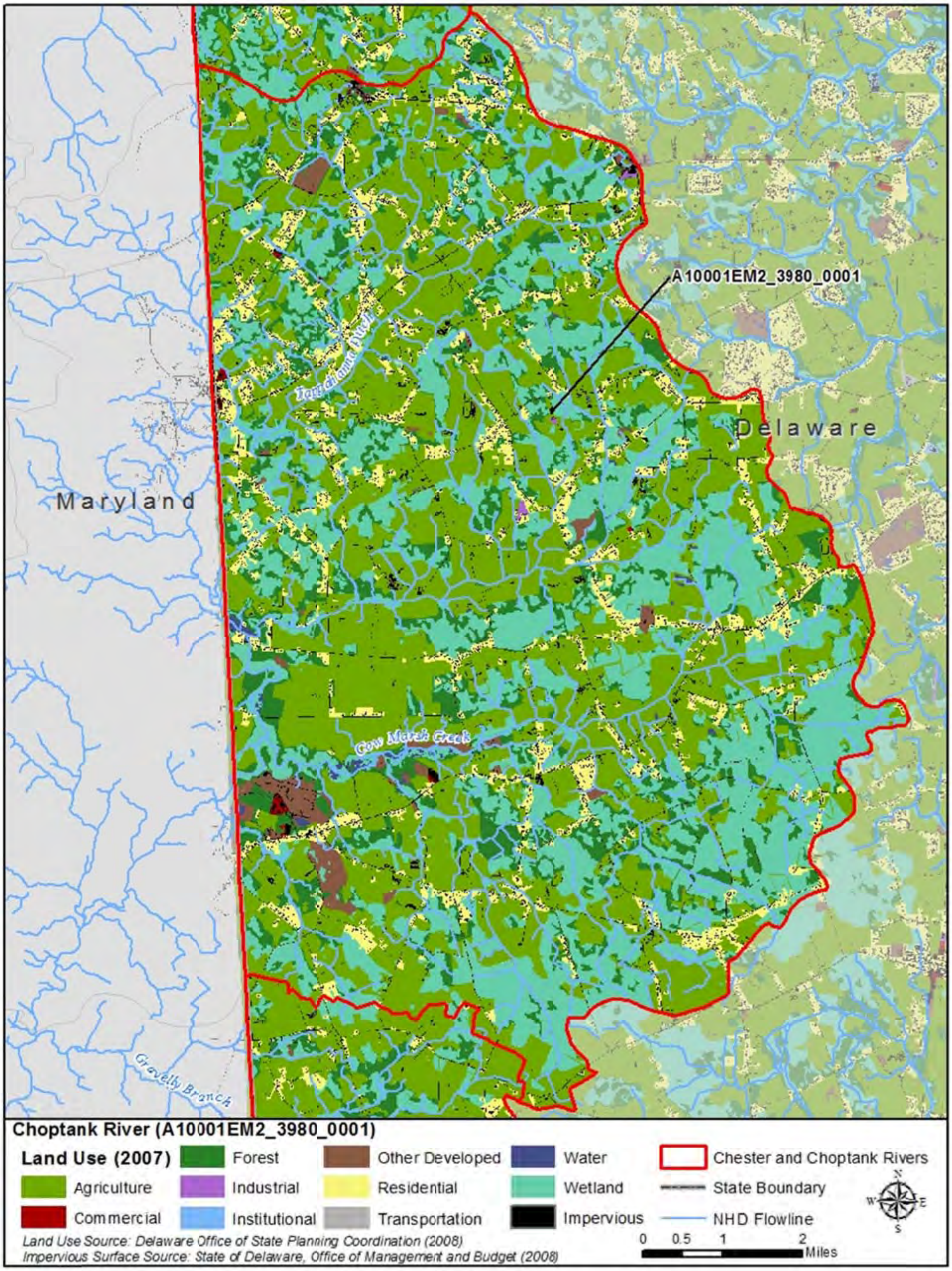


Figure 9: Choptank River (A10001EM2_3980_0001) Land Use and Impervious Surface

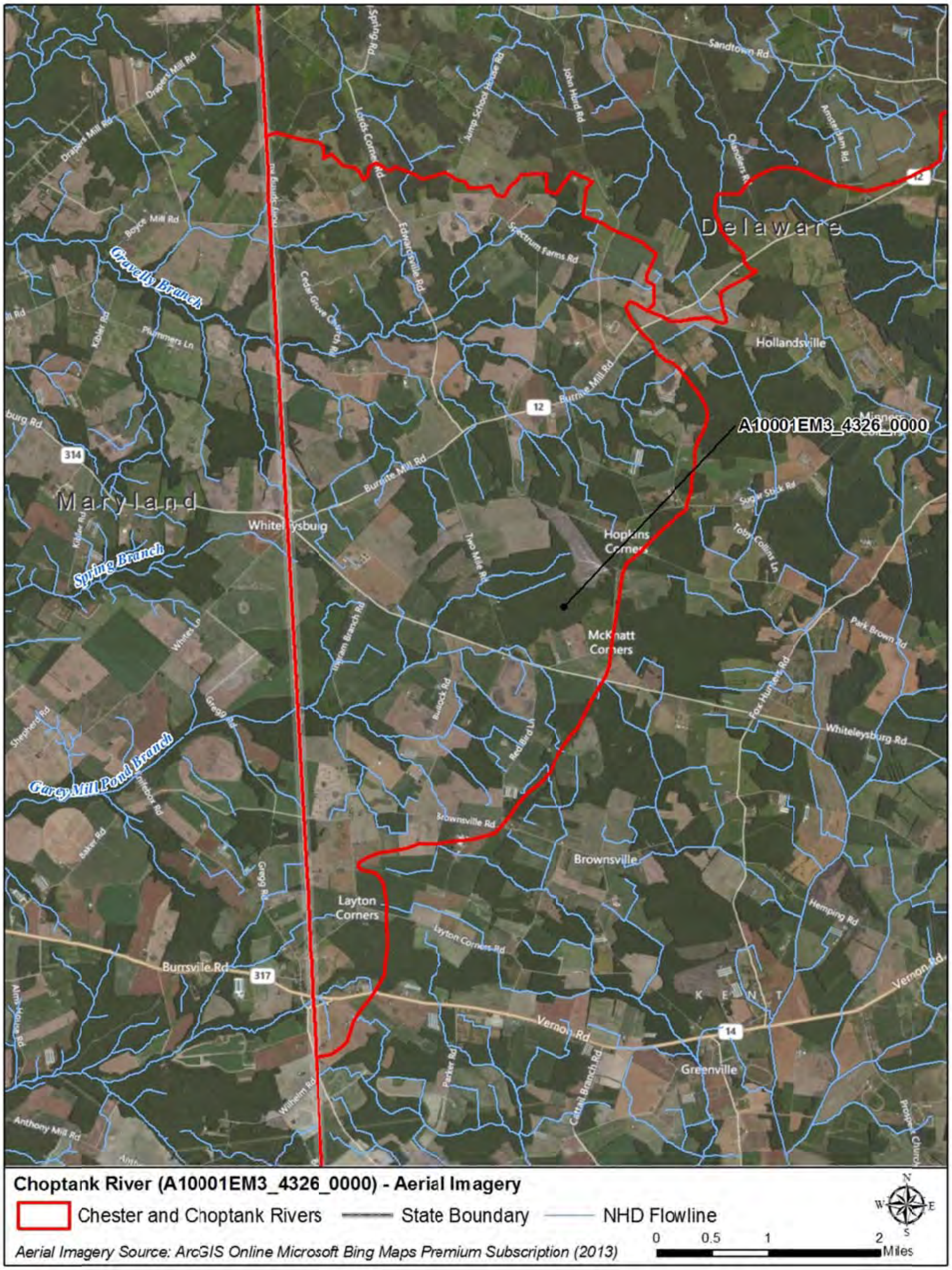


Figure 10: Choptank River (A10001EM3_4326_0000) Aerial Imagery

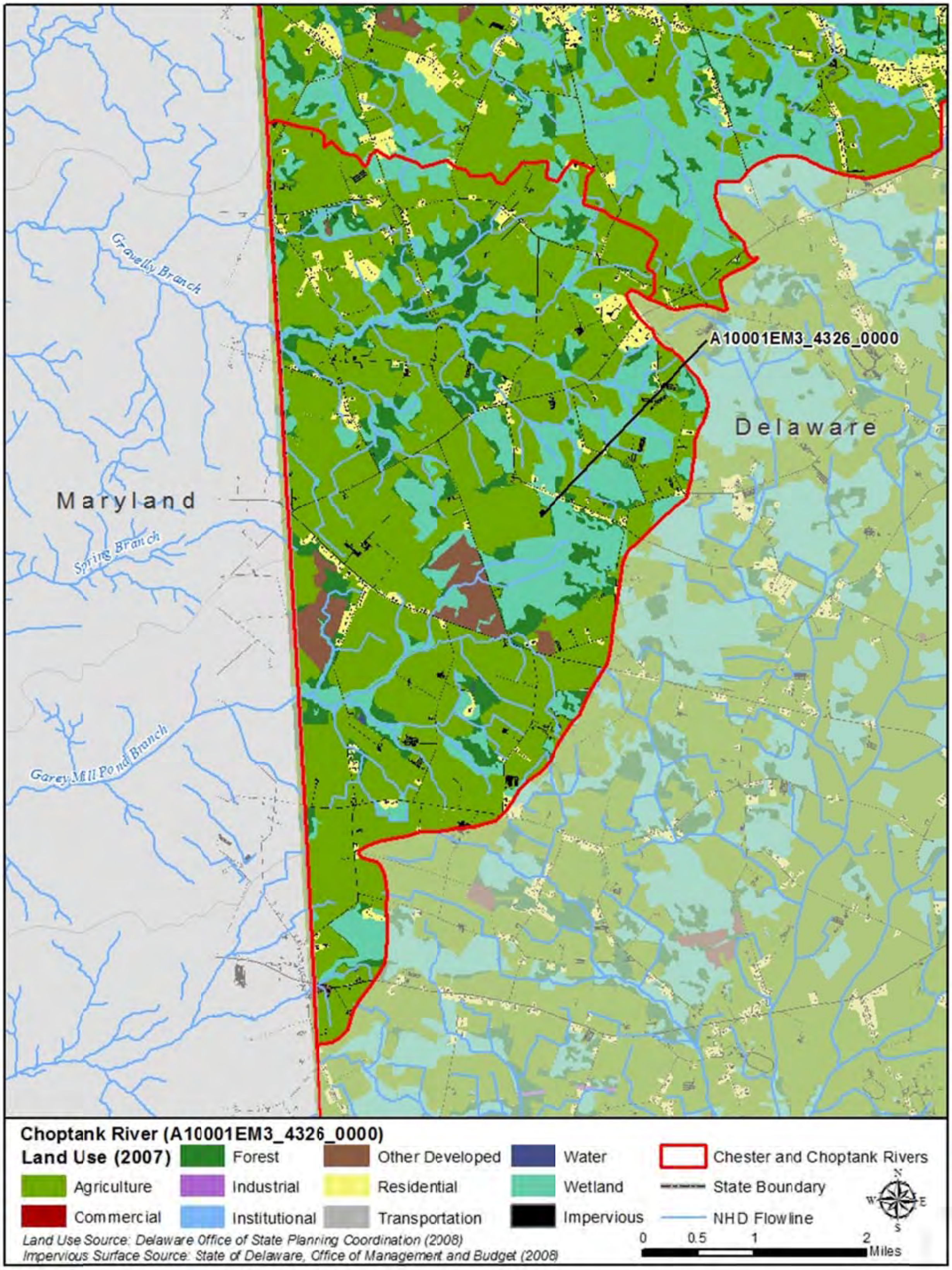


Figure 11: Choptank River (A10001EM3_4326_0000) Land Use and Impervious Surface

2.4 Water Quality

2.4.1 Use Designations

Following Title 7 of Delaware's Administrative Code for Natural Resources & Environmental Control (7400 Watershed Assessment Section, 7401 Surface Water Quality Standards), the Use Designations for the Chester and Choptank waterbodies are presented in Table 4. The designations for each waterbody in the planning unit are identical and include water supply, contact recreation and aquatic life uses.

Table 4: Use Designations of the Chester River and Choptank River

Waterbody	Chester River	Choptank River
Public Water Supply Source	-	-
Industrial Water Supply	X	X
Primary Contact Recreation	X	X
Secondary Contact Recreation	X	X
Fish, Aquatic Life & Wildlife*	X	X
Cold Water Fish (Put-and-Take)	-	-
Agricultural Water Supply**	X	X
ERES Waters***	-	-
Harvestable Shellfish Waters	-	-

Source: http://regulations.delaware.gov/AdminCode/title7/7000/7400/7401.pdf
*waters of Exceptional Recreational or Ecological Significance
**freshwater segments only
*** Includes shellfish propagation

2.4.2 303(d) Impairments

According to Delaware's 2012 303(d) list of impaired waters (DNREC, 2012a), several segments within the Chester and Choptank planning unit are listed for water quality impairments. Category 5 waters for the Chester River watershed, which include those waters that are not meeting their use designation and require a TMDL, include the mainstem and tributaries of Cypress Branch, Sewell Branch, and Gravelly Run. For the Choptank River watershed, Category 5 waters include the mainstem and tributaries to Tappahanna Ditch, Culbreth Marsh Ditch, and Cow Marsh Branch. With an exception to one temperature stressor listed in Culbreth Marsh Ditch, the majority of stressors listed include biology and habitat with non-point sources indicated as the probable source of impairment. The total stream mileage includes 17.3 miles of stream for the Chester River watershed and 56.3 miles of stream for the Choptank River watershed (73.6 miles total).

2.4.3 TMDLs

Both the Chester and Choptank watersheds have local TMDL regulations for nutrients (i.e., nitrogen and phosphorus); which, were established in 2005 in response to the several 303(d) listings mentioned in the previous section (Section 2.4.2; DNREC 2005). The TMDL regulations for the Chester and Choptank watersheds include a cap of nonpoint source nitrogen and phosphorus loads in the entire watershed. In addition, a TMDL for bacteria was established in 2006 for the Chesapeake Bay Drainage Basin, which includes Chester River and Choptank River (DNREC, 2006).

The Upper Chesapeake Watershed Tributary Action Team Pollution Control Strategy Recommendations were established January 31, 2008 to achieve nutrient reductions specified in the TMDL regulations (DNREC, 2008).

Additionally, both the Chester River and Choptank River are a part of the Chesapeake Bay TMDL for nitrogen, phosphorus, and sediment.

2.4.4 NPDES

The Federal Clean Water Act requires a NPDES permit to discharge pollutants through a point source into a "water of the United States". In Delaware, New Castle County and the Delaware Department of Transportation (DelDOT) are co-permittees on the State's only MS4 NPDES permit. Current data indicates that there are no regulated impervious or pervious developed areas within the Chester and Choptank planning area.

2.5 Anticipated Growth

According to the Phase II WIP, future growth is expected to occur across the Chesapeake drainage dependent on local land use and planning. The majority of the Chester and Choptank planning unit (127.4 square miles) is located within Kent County, Delaware, with a small portion (10.3 square miles) also in New Castle County, Delaware.

The Kent County Comprehensive Plan was last updated in 2007 and approved in 2008. The next update of the plan is due by October 2018 with a review of the plan to be completed by October 2013 (DWIC, 2012). The primary developed areas included in this section of the county are Dover and Harrington, Delaware, which are located 6.5 miles and 6.0 miles, respectively, east of the headwaters of Choptank River. According to the 2000 census data, Kent County's population density was 126,697 people, which was a 13.5% increase over the 1990 census population (KCCP, 2008). The population in Kent County is projected to grow to 189,431 people in 2030, which is an increase of 49.5% from 2000. However, while the population is projected to continually increase from 2005 to 2030, the rate of increase is projected to decrease markedly every five years (e.g., 12.8% population change from 2000-2005 to a 3.6% population change projected from 2025 to 2030; KCCP, 2008).

The Kent County Comprehensive Plan expressed goals to make major capital improvements to the wastewater system including wastewater plant improvements to increase capacity and meet environmental standards (i.e., TMDL compliance), conveyance system and system capacity improvements, and sanitary sewer expansions.

The New Castle County Comprehensive Plan was last updated in 2011. New Castle County has a goal to implement regional wastewater service for the entire New Castle County portion of the Bay watershed by 2025 through a 'Septic Elimination Program'. Additionally, to reduce the use of septic systems in future growth in areas targeted as Long Term Wastewater Expansion Areas, the County has established large lot subdivision requirements and has passed ordinances restricting private utility wastewater treatment plants (DWIC, 2012).

New Castle County continues to utilize strategies such as limiting impervious cover, promoting low impact development, and implementing stormwater retrofits for water quality treatment. The County will continue to work with (DelDOT) to address requirements of the NPDES MS4 permit including meeting TMDL goals.

3 Causes and Sources of Impairment (a)

The causes and sources of impairment and expected load reductions for the Chester and Choptank watersheds were identified using data from the TMDL Analyses for Chesapeake Bay Drainage Basin, Delaware (DNREC, September 2006) and TMDL Analysis for Chesapeake Drainage Watersheds, Delaware: Chester River, Choptank River, and Marshyhope Creek (DNREC, December 2005). The Chester and Choptank each have TMDLs for nitrogen, phosphorus, and bacteria.

The Chester and Choptank River Watersheds are predominantly comprised of agricultural, forest and wetland land uses. Hartly, which lies on the southern border of the Chester and the northern border of the Choptank watershed, is the only incorporated town. Based on data from the TMDL Analyses for Chesapeake Drainage Watersheds, Delaware: Chester River, Choptank River, and Marshyhope Creek (DNREC, December 2005), the land use activity in the Chester watershed consists of 45 km^2 of agriculture (44% of the watershed), 35 km^2 of wetland (34% of the watershed), 12 km^2 of forest (12% of the watershed), 10 km^2 of residential, commercial and industrial area (9% of the watershed), and 1 km^2 of rangeland (1% of the watershed). The summary geographic distribution of different land uses in the Chester is in Figure 12.

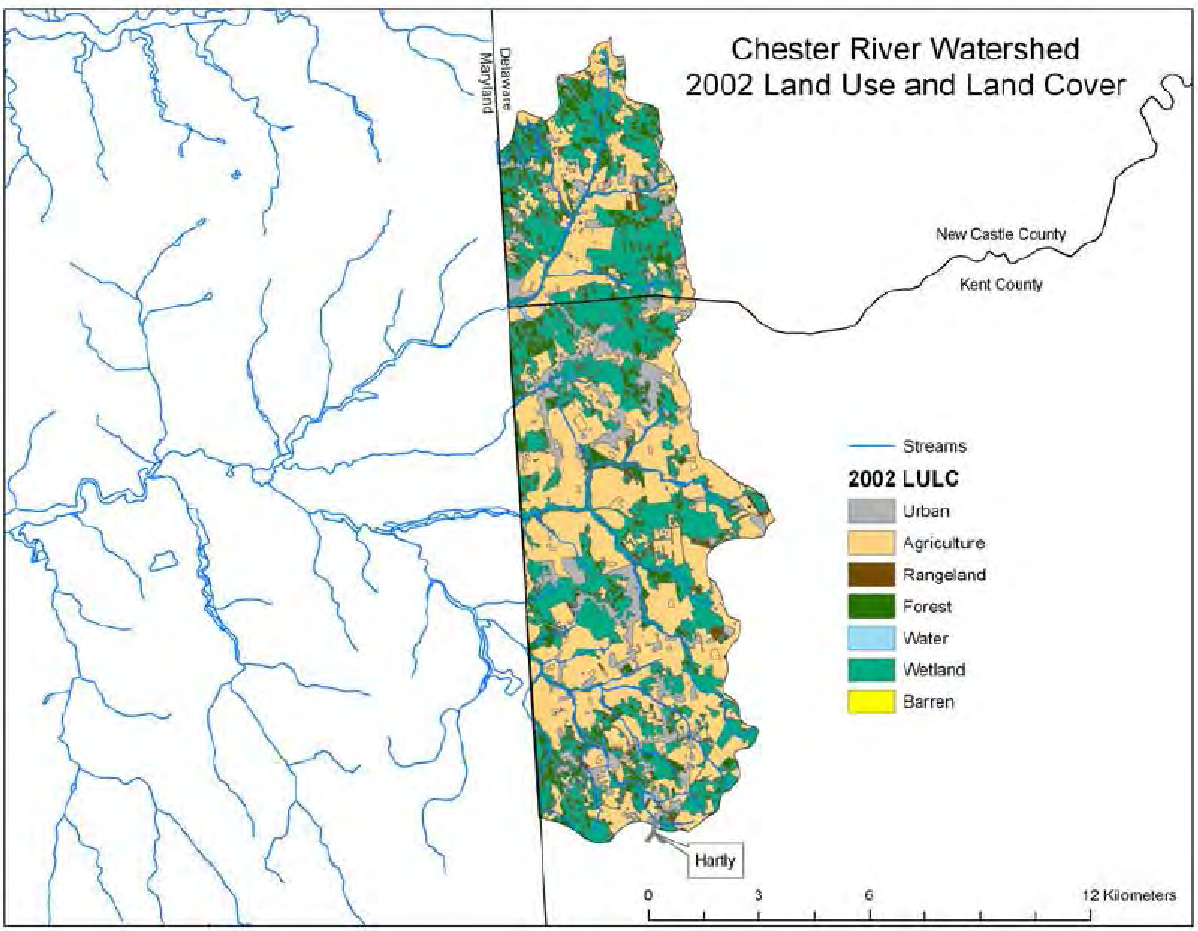


Figure 12: Distribution of land use in Chester River, from the TMDL Analysis (DNREC, 2005)

The land use activity in the Choptank River watershed consists of 125 km^2 of agriculture (50% of the watershed), 67 km^2 of wetland (27% of the watershed), 31 km^2 of forest (13% of the watershed), 23 km^2

of residential, commercial and industrial area (9% of the watershed), and 3 km^2 of rangeland (1% of the watershed). The summary geographic distribution of different land uses is presented in Figure 13.

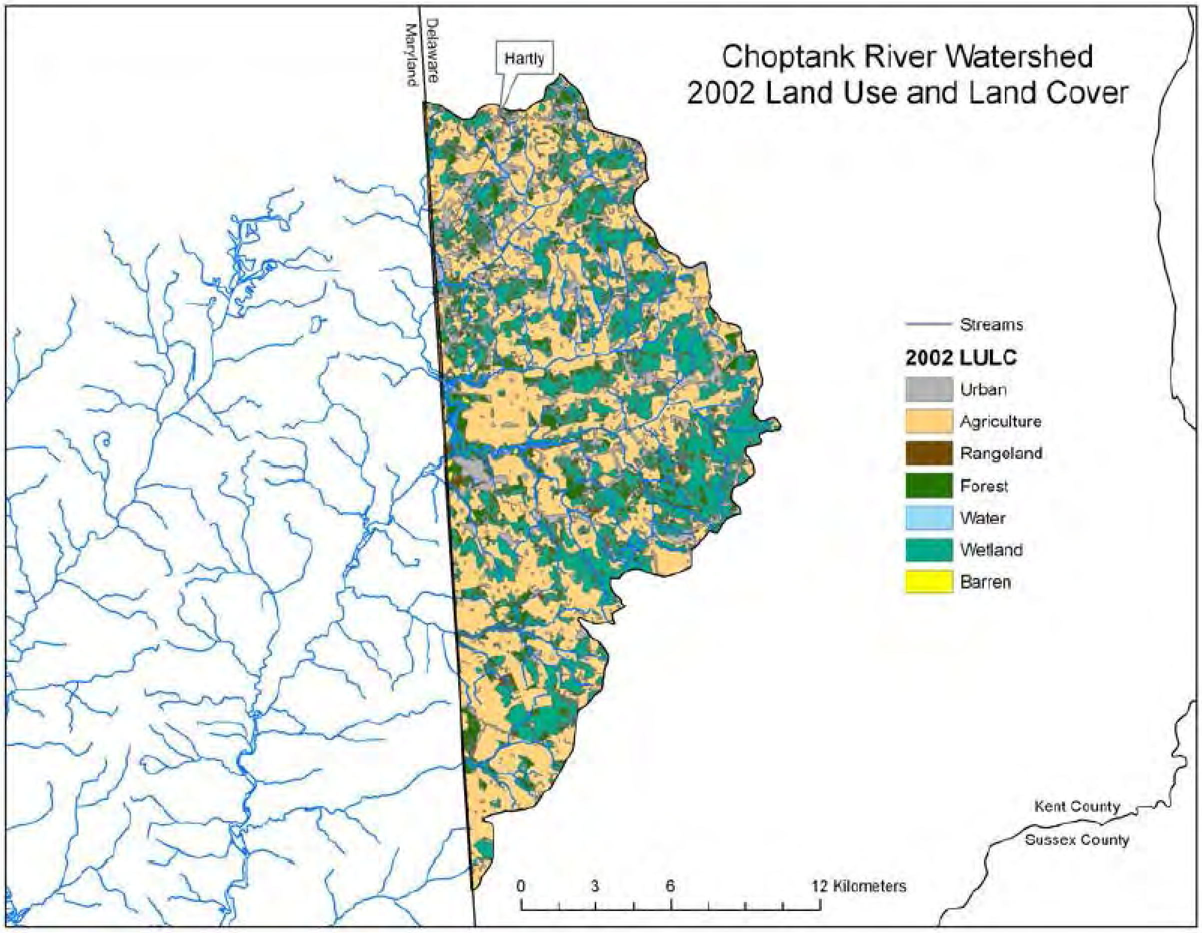


Figure 13: Distribution of land use in Choptank River, from the TMDL Analysis (DNREC, 2005)

To support and calibrate the model, intensive monitoring was conducted between 2001 and 2003. These monitoring stations are presented in Table 5 with the STORET identification number, which is a cataloging number for EPA's STOrage and RETrieval repository.

Table 5: Monitoring Stations in the Chester and Choptank River Watersheds

Monitoring Location	STORET No.	TMDL (active during 2001-2003)
Chester River Watershed *- Cypress Branch Sub-watershed*		
1. Cypress Branch at Morris Rd. (Rd. 477)	112581	√
2. Cypress Branch at Clayton Delaney Rd. (Rd. 40)	112011	√
Chester River Watershed *- Sewell Branch Sub-watershed*		
1. Sewell Branch at Blackiston Church Rd. (Rd. 131)	112591	√
2. Sewell Branch at Sewell Branch Rd. (Rd. 95	112021	√

Monitoring Location	STORET No.	TMDL (active during 2001-2003)
3. Jordan Branch at Underwoods Corner Rd. (Rd. 94)	112601	√
Chester River Watershed *- Gravelly Run Sub-watershed*		
1. Gravelly Run at Fords Corner Rd. (Rd. 98)	112621	√
2. Gravelly Run at Lion Hope Rd. (Rd. 143)	112611	√
3. Gravelly Run at Stulltown Rd., MD	112031	√
4. Muddy Bottom Ditch at Downs Chapel Rd. (Rd. 97)	112631	√
Choptank River Watershed		
1. Tappahanna Ditch at Route 8 bridge	207121	√
3. Tappahanna Ditch at Tuxward Rd. (Rd. 220)	207131	√
3. Tappahanna Ditch at Sandy Bend Rd. (Rd. 222)	207081	√
4. Tidy Island Creek at Westville Rd. (Rd. 206)	207171	√
5. Culbreth Marsh Ditch at Oak Point School Rd. (Rd. 215)	207151	√
6. Culbreth Marsh Ditch at Luck's Dr. (Rd. 223)	207141	√
7. Culbreth Marsh Ditch at Shady Bridge Rd. (Rd. 210)	207091	√
8. Cow Marsh Creek at Willow Grove Rd. (Rt. 10)	207191	√
9. Cow Marsh Creek at Hollering Hill Rd. (Rd. 213)	207181	√
10. Cow Marsh Creek at Mahan Corner Rd. (Rd. 208)	207021	√
11. Mud Millpond Outflow at Mud Mill Rd. (Rd. 207)	207161	√
12. Choptank River at Willow Grove Rd., MD (Rd 287)	207031	2005 only
13. White Marsh Branch at Cedar Grove Church Rd. (Rd. 268)	207111	√

3.1 Nutrients

The monitoring data in the Chester/Choptank showed that occasional dissolved oxygen violations occurred at all nine monitoring sites, with concentrations below 5.5 mg/l occurring most often during summer months. Average concentration collected between January 2005 and April 2005 at station 207031 showed the same results. Nitrogen levels were below the State of Delaware's total nitrogen target threshold value of 3.0 mg/l at all stations but two, with ranges between 0.2 mg/l and 5.8 mg/l. Phosphorus levels ranging between 0.01 mg/l and 0.7 mg/l were relatively high and exceeded the 0.2 mg/l target for total phosphorus at all stations, but one. Based on the monitoring data, Delaware's 2004 305(b) Report (4) showed that elevated nutrient levels and low DO concentrations impaired Chester/Choptank River Watersheds.

Table 6: Average water quality conditions at monitoring locations in the Chester/Choptank River Watersheds during 2001-2003

Monitoring Station	Water Temp C	Field DO mg/l	BOD5 mg/l	Chlor-a ug/l	Org-N mg/l	NH3-N mg/L	NO2-N mg/l	NO3-N mg/l	TN mg/l	Org-P mg/l	Dis-P mg/l	TP mg/l
Chester-Cypress Branch												
112581	15.82	4.77	2.63	19.73	1.2	0.11	0.02	0.2	1.53	0.11	0.05	0.16
112011	14.72	5.17	2.51	6.14	0.9	0.1	0.04	0.32	1.35	0.08	0.03	0.11
Chester-Sewell Branch												

Monitoring Station	Water Temp C	Field DO mg/l	BOD5 mg/l	Chlor-a ug/l	Org-N mg/l	NH3-N mg/L	NO2-N mg/l	NO3-N mg/l	TN mg/l	Org-P mg/l	Dis-P mg/l	TP mg/l
112591	13.72	6.72	2.46	8.03	0.88	0.21	0.09	0.85	2.03	0.21	0.12	0.33
112021	13.83	6.52	2.4	3.79	0.81	0.14	0.14	1.25	2.25	0.13	0.1	0.23
112601	13.91	8.48	2.42	2.61	0.63	0.06	0.12	1.08	1.89	0.11	0.08	0.18
Chester-Gravelly Run												
112621	15.16	6.34	2.73	7.8	0.65	0.12	0.04	0.35	1.15	0.13	0.04	0.16
112611	13.34	8.19	2.41	3.19	0.59	0.06	0.08	0.71	1.44	0.08	0.05	0.13
112031	14.32	7.78	2.41	2.1	0.68	0.12	0.09	0.77	1.65	0.11	0.09	0.2
112631	15.08	8.41	2.55	13.86	0.72	0.07	0.05	0.43	1.27	0.11	0.04	0.15
Choptank - Tappahanna Ditch												
207121	16.27	5.21	2.67	16.98	0.68	0.13	0.03	0.27	1.06	0.15	0.04	0.19
207131	16	6.89	3.26	51.51	1.39	0.14	0.05	0.44	2.01	0.31	0.03	0.34
207081	16.28	7.29	2.4	5.04	0.72	0.09	0.07	0.64	1.53	0.08	0.03	0.11
207171	16.61	6.96	2.4	2.41	0.68	0.11	0.08	0.7	1.57	0.09	0.04	0.13
Choptank - Culbreth Marsh Ditch												
207151	16.94	4.27	3.79	53.29	0.88	0.15	0.02	0.21	1.14	0.23	0.06	0.29
207141	16.65	6.38	2.4	4.24	0.61	0.11	0.07	0.61	1.4	0.12	0.03	0.15
207091	16.8	6.84	2.57	11.32	0.81	0.15	0.15	1.36	2.48	0.12	0.04	0.16
Choptank - Cow Marsh Creek												
207191	16.68	5.34	2.5	5.44	0.55	0.05	0.02	0.17	0.78	0.09	0.02	0.11
207181	16.55	7.43	2.4	8.03	0.62	0.07	0.04	0.39	1.13	0.07	0.02	0.09
207021	17.06	6.75	2.4	2.88	0.59	0.11	0.09	0.79	1.58	0.07	0.02	0.09
Choptank Mainstem - Choptank River												
207161	17.81	7.1	2.4	7.97	0.8	0.12	0.08	0.71	1.7	0.12	0.03	0.15
207031*	4.13	12.04	2.4	2.78	0.35	0.1	0.14	1.25	1.83	0.08	0.04	0.12
Choptank - White Marsh Branch												
207111	16.32	6.67	2.4	3.5	0.87	0.11	0.3	2.73	4.02	0.07	0.04	0.12

*Station 207031 was sampled during the modeling phase of the project; therefore the averages for this station are from January 2005 through April 2005.

3.2 Bacteria

The State of Delaware water quality standard for enterococcus bacteria is a geometric mean of 100 CFU/100 ml. Enterococci are present in fecal material and are used as an indicator organism with which a correlation to illness rates can be established. The level of risk associated with primary contact recreation in waters with an enterococcus concentration of 100 CFU/100 ml has been deemed appropriate and is the basis for the current State of Delaware water quality standards for bacteria. The bacteria concentrations in the Chester/Choptank River Watersheds consistently exceeded the 100 CFU/100 mL bacteria standard in monitoring conducted between 10/28/1995 and 10/10/2006.

3.3 Sources

3.3.1 Wastewater

There are no permitted WWTP, CSO, or Industrial facilities in the Chester/Choptank watershed.

3.3.2 Urban

The urban sector in the Chester/Choptank watershed is comprised of nonregulated developed land. There are no municipal separate storm sewer systems (MS4s). Urban is not considered a significant source of nutrients or bacteria in the Chester/Choptank watersheds.

3.3.3 Agriculture

The agricultural land uses are dominant in this watershed. There are four animal operations in the Chester River Watershed and 32 in the Choptank River Watershed (DNREC, 2005). There are no permitted CAFOs in the Chester/Choptank. However, there are numerous notices of intent under consideration. Animal operations are considered substantial sources of nutrients and bacteria from manure. In addition, cropland, where manure and inorganic nutrients are spread, is also considered a substantial source of nutrients. There are many USDA cost-shared practices to control these loads, cropland and animal operations are a critical area with a high recovery potential.

3.3.4 Septic

Onsite wastewater treatment and disposal systems, or septic systems, exist in this predominant rural watershed. There are more than 1,400 systems in the Chester River Watershed, and approximately 3,700 in the Choptank River Watershed. While the overall septic load likely is not substantial compared to other sources, a key management measure is to prevent growth in this load.

3.3.5 Forest

The forested land is a low loading land use. Many management measures seek to convert less productive land into forest, improve forest harvesting techniques, or to add a forested buffer down slope from a higher loading land use.

3.4 Summary

The critical sources of nitrogen, phosphorus and bacteria in the Chester/Choptank watershed are agricultural land uses. While monitoring data provides the concentration of pollutants, it does not indicate the source. However, manure is likely the dominant cause of both the nutrient and bacteria pollution. Fortunately, manure management is a targeted area by USDA cost-share programs. The overall goals of this watershed management plan and the Chester and Choptank TMDLs are presented in the following section.

4 Expected Load Reductions (b)

4.1 Nutrients

The required nutrient load reductions for the Chester and Choptank local TMDLs were estimated using a cumulative distribution function method. This method is described in detail in the TMDL Analyses (DNREC, 2006). The local TMDLs publish allocated loads in lbs/day; however, for the purpose of this

Watershed Management Plan, these loads were converted to lbs/year. The TMDLs established for the Chester and Choptank River Watersheds capped nonpoint nitrogen loads at the 2001-2003 baseline levels and nonpoint phosphorus loads reduced by 40% from the 2001-2003 baseline levels (State of Delaware, 2006a; 2006b). As stated in the Chester and Choptank local TMDLs, nitrogen loads will be capped at 2001-2003 baseline levels of 258,600 lbs/year (708 lbs/day) for the Chester and 496,400 lbs/year (1,359 lbs/day) for the Choptank. Phosphorus reductions of 8,140 lbs/year (22.3 lbs/day) are required for the Chester, and phosphorus load reductions of 18,670 lbs/year (51.1 lbs/day) are required for the Choptank. Baseline loads in the Chester and Choptank for phosphorus are 19,940 lbs/year (54.6 lbs/day) and 46,390 lbs/year (127 lbs/day), with TMDL allocated loads set to 11,800 lbs/year (32.3 lbs/day) and 27,720 lbs/year (75.9 lbs/day), respectively.

While neither TMDL specified the sector responsible for the nonpoint source loads, the Chester and Choptank are dominated by agriculture which is assumed to be the source. As such, the source of impairment is dominated by nonpoint source agriculture. The management measures discussed in following sections target the source of nutrients and bacteria from the nonpoint source agricultural load.

Projected reductions in loads are a result of applying various BMPs at various levels to the nonpoint source agricultural sector. These reductions were estimated using the Chesapeake Bay Program Partnership's Watershed Model Phase 5.3.2, which calculates the annual loads under various management scenarios. The suite of BMPs that produced the loads discussed in this section is discussed in detail in Section 5: Management Measures.

The expected load reductions are accurate assuming constant initial conditions. As land use changes from agriculture to developed, more of the nonpoint load will come from those developed source sectors (urban, septic). The total load cannot increase because of the requirements of the 2010 Bay TMDL which requires growth offset measures. Section 5: Management Measures addresses offsetting new and increased loads.

The load reductions proposed in this section meet or exceed the allocations for the Chester and Choptank in the local TMDLs. The allocations were established to ensure that Delaware implements adequate pollution control practices to meet the water quality standards. These load reductions are specific to each source. While the TMDL did not split out pollutant loads by source sector, this watershed is dominated by agriculture and the load reductions are proposed to be reduced from the nonpoint source agricultural load. Each source is broken into various land uses, and these land uses are addressed separately. The load reduction for each subwatershed is presented for each land use at the end of the section.

By targeting the most effective BMPs to the critical areas with the greatest recovery potential, the TN agriculture load can be decreased to 258,902 pounds per year. The TN urban load is another priority area and this load can be reduced to 22,578 pounds per year. The TN load from septic systems is a controllable load so it is also a priority. This load can be reduced to 16,553 pounds per year (Figure 14). With these reductions, the Chester and Choptank TMDL reduction loads are met.

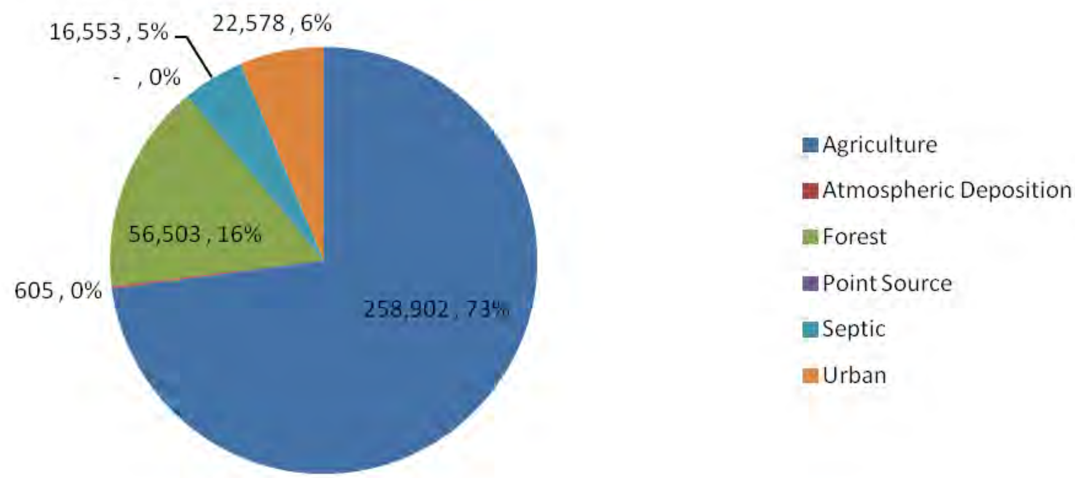


Figure 14: Expected delivered total nitrogen loads by source sector in the Chester/Choptank.

The agricultural TP loads in the Chester/Choptank can be reduced to 19,970 pounds per year. Urban TP loads can be reduced to 1,792 pounds per year (Figure 15). These significant reductions are possible because of the management measures that can be taken to reduce excreted phosphorus concentrations from animals and water control structures in all tax ditches. These are discussed in Section 5: Management Measures. With these reductions, the Chester and Choptank TMDLs are met.

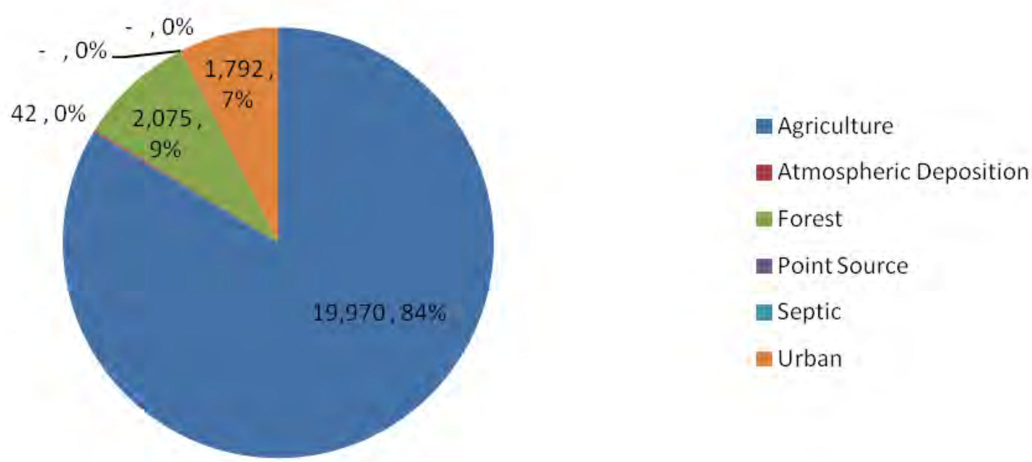


Figure 15: Expected delivered total phosphorus loads by source sector in the Chester/Choptank by 2025.

Table 7 provides a summary of the projected TN and TP pounds per year once all recommended management measures are implemented and take effect. That is, implementing a forest buffer may not take full effect for five to ten years, since the trees must approach maturity before the full nutrient reduction benefit is realized. However, the table reflects the load once the BMPs take effect. Also, there will be lag time related to groundwater and storage within the stream system. These projected loads are consistent with the TMDLs for the Chester and Choptank watersheds.

Table 7: Projected loads by sector to meet the Chester and Choptank TMDLs for nutrients.

Sectors	Delivered Total Nitrogen (lbs/year)	Delivered total Phosphorus (lbs/year)
Chester River		
Agriculture	**73,303**	**5,478**
crop	65,543	4,235
nursery	840	302
pasture/hay	3,563	363
production area	3,357	578
Atmospheric Deposition	**177**	**11**
Forest	**20,954**	**696**
Point Source	**-**	**-**
Septic	**5,491**	**-**
Urban	**7,814**	**566**
Construction	129	21
Extractive	-	-
Impervious developed	2,901	341
Pervious Developed	4,784	204
Total	**107,739**	**6,751**
Chester TMDL Allocation	**258,597**	**11,798**
Choptank River		
Agriculture	**185,599**	**14,492**
crop	169,618	11,728
nursery	1,920	766
pasture/hay	7,668	803
production area	6,393	1,194
Atmospheric Deposition	**428**	**31**
Forest	**35,549**	**1,379**
Point Source	**-**	**-**
Septic	**11,062**	**-**
Urban	**14,764**	**1,226**
Construction	237	41
Extractive	113	29
Impervious developed	6,002	787
Pervious Developed	8,411	370
Total	**247,402**	**17,128**
Choptank TMDL Allocation	**496,375**	**27,723**

In the urban sector, the majority of the TN and TP load reductions will come from the pervious developed land use. This land use generally is the most cost-effective to treat. The urban TSS loads will primarily be reduced from the construction land use where there are many controls that can be implemented.

The agricultural sector will see the majority of reductions from crop land. Some of these reductions will be by converting crop land to pasture or hay. Therefore, there is an increase in the pasture/hay land use loads, but an overall reduction in agriculture.

Nitrogen load reductions from septic systems are expected by increasing pump out, inspection and utilizing advanced treatment for septic systems. Hookups to wastewater treatment plants (WWTPs) will also reduce the septic load.

The forest sector is a low loading land use. By adding almost 200 more acres of land into forest, reductions are gained.

Atmospheric deposition is a source that is not planned to be addressed by Delaware. Rather, EPA's Clean Air Act is anticipated to address this load. Much of the nitrogen air deposition in Delaware is generated in other states. Delaware is focusing its efforts on increasing forest land cover which trap air-borne nitrogen so that it does not enter the waterways.

4.2 Bacteria

The Chester and Choptank TMDLs each require the watershed to reach reductions as defined in Table 8. The primary source of bacteria in these predominantly agricultural watersheds is animal manure. Water quality samples will continue to be collected to ensure the required reductions are achieved. The specific management measures that are used to decrease bacteria are presented in the following section: Management Measures (c).

Table 8: Chester/Choptank TMDL Bacteria Reductions

Watershed	Pollutant	Baseline CFU / day	% Reduction	TMDL Allocation CFU/day
Chester	Bacteria	1.5E+11	37%	9.45E+10
Choptank	Bacteria	3.8E+11	29%	2.70E+11

5 Management Measures (c)

Best management practices (BMPs) are either already implemented or are planned for implementation to achieve the Chester and Choptank TMDL load reductions. These TMDL loads were discussed in the previous section—4: Expected Load Reductions. The type and level of BMPs implementation included in this section, will meet the reduction and loading goals of both the Chester and Choptank TMDLs. This section discusses the planned BMPs and compares them to the baseline BMPs. Baseline BMPs are those that were implemented through June 30, 2012.

Each BMP provides a reduction for nitrogen, phosphorus, or bacteria. An annual pollutant load that meets the TMDL allocations is estimated for each source sector with the indicated BMPs implemented. The pollutant load for both the Chester and Choptank watersheds was determined using the

Chesapeake Assessment Scenario Tool (CAST), which calculates BMPs identically to the Chesapeake Bay Program Partnership Watershed Model.

CAST is a model created and supported by EPA Region 3. CAST is a web-based pollutant load estimator tool that streamlines environmental planning. Users specify a geographical area, and then select BMPs to apply on that area. CAST builds the scenario and provides estimates of pollutant load reductions. The cost of a scenario is also provided so that users may select the most cost-effective practices to reduce pollutant loads. CAST allows users to understand which BMPs provide the greatest load reduction benefit, the extent to which these BMPs can be implemented, and the cost of these BMPs. Based on the scenario outputs, users can refine their BMP choices in their planning. CAST facilitates an iterative process to determine if TMDL allocations are met. Scenarios may be compared to each other, TMDL allocations, or the amount of pollutants reduced by current BMP implementation. CAST estimates of load reductions for point and nonpoint sources include: agriculture, urban, forest, and septic loading. CAST stores the geographic area, cost and implementation level associated with each BMP as well as the load for each sector and land use. With these data tables, CAST also serves as a data management system. Thus, users may quantify the impacts of various management actions while improving local management decisions.

CAST is designed to be useful to people with a general knowledge of BMPs. Knowledge of models or BMP load reduction calculations is not necessary. CAST is available on-line to users with a login and password, which may be requested from the website. More information on the sequence of BMP application is found in the CAST technical manual file posted under documentation on the website: CASTTOOL.ORG.

Data is entered into CAST in the following sequence:

- The user selects a geographic area, such as a county.
- CAST draws upon the same data sources as the Chesapeake Bay Program Partnership models to populate the parameters of the scenario based on user selections. The user can build a new scenario or import features of an existing scenario. The user may opt to share the scenario with other users on the system.
- The user establishes costs of BMPs, or can use the defaults provided.
- The user adds BMPs to the scenario using separate screens with options for urban, septic, forest, agriculture, animals, and manure transport. The user may edit the BMP selections at any time to modify the scenario.
- The user selects calculate and the loads and costs are provided on screen and in downloadable tables.
- The user also may compare scenarios.

Load reductions are not tied to any single BMP, but rather to a suite of BMPs working in concert to treat the loads. The Watershed Model calculates BMPs as a group, much like a treatment train. For those BMPs with individual effectiveness values, the load reduction can vary depending on other BMPs that are implemented. This is because some BMPs are land use change BMPs and also because some BMPs are mutually exclusive or overlapping. This section presents the level of BMP implementation. Section 9 presents information on how progress toward load reductions will be evaluated and management plans adapted on an on-going basis.

The priority areas treated were previously identified and include construction, cropland, and septics. The most critical BMPs are those identified in the Upper Chesapeake Watershed Tributary Action Team Pollution Control Strategy Recommendations of January 31, 2008.

5.1 Nutrients

5.1.1 Wastewater

There are no permitted WWTP, CSO, or Industrial facilities in the Chester or Choptank watershed. Connections to the Kent County wastewater treatment plant may be considered to reduce septic loads.

5.1.2 Urban

The urban sector is currently making use of six structural BMPs to reduce nitrogen and phosphorus loads. The Upper Chesapeake Watershed Tributary Action Team Pollution Control Strategy Recommendations (2008) identified dry extended detention ponds, infiltration, filtering practices and wet ponds. These practices, in addition to the others listed here, keep the focus on “green technology” to reduce impervious surfaces. Redevelopment will make use of filtering practices and new development will make greater use of practices possible with low impact development. When cost-effective, the use of these practices will be expanded and refocused to assure recovery. These BMPs were selected specifically for three reasons: 1) effectiveness for water quality improvement, 2) willingness among the public to adopt, and 3) implementable in multiple facility types without limitations by zoning or other controls. The practices include:

- **Bioretention** — An excavated pit backfilled with engineered media, topsoil, mulch, and vegetation. These are planting areas installed in shallow basins in which the storm water runoff is temporarily ponded and then treated by filtering through the bed components, and through biological and biochemical reactions within the soil matrix and around the root zones of the plants.
- **Bioswales** —A bioswale is a stormwater conveyance that reduces loads because, unlike other open channel designs, there is now treatment through the soil. A bioswale is designed to function similarly to bioretention.
- **Extended detention (ED) dry ponds** — Dry extended detention basins are depressions created by excavation or berm construction that temporarily store runoff and release it slowly via surface flow or groundwater infiltration following storms. Dry extended detention basins are designed to dry out between storm events, in contrast with wet ponds, which contain standing water permanently. As such, they are similar in construction and function to dry detention basins, except that the duration of detention of stormwater is designed to be longer, theoretically improving treatment effectiveness.
- **Filtering practices** (biofiltration, filter strip, filtration, forebay micropool) — Practices that capture and temporarily store runoff and pass it through a filter bed of either sand or an organic media. There are various sand filter designs, such as above ground, below ground, perimeter, etc. An organic media filter uses another medium besides sand to enhance pollutant removal for many compounds due to the increased cation exchange capacity achieved by increasing the organic matter. These systems require yearly inspection and maintenance.
- **Infiltration** — A depression to form an infiltration basin where sediment is trapped and water infiltrates the soil. No underdrains are associated with infiltration basins and trenches, because by definition these systems provide complete infiltration. Design specifications require infiltration basins and trenches to be built in good soil, they are not constructed on poor soils,

such as C and D soil types. Engineers are required to test the soil before approved to build is issued. Yearly inspections to determine if the basin or trench is still infiltrating runoff are planned.

- **Wet ponds or wetlands** — A water impoundment structure that intercepts stormwater runoff then releases it to an open water system at a specified flow rate. These structures retain a permanent pool and usually have retention times sufficient to allow settlement of some portion of the intercepted sediments and attached nutrients/toxics. Until recently, these practices were designed specifically to meet water quantity, not water quality objectives. There is little or no vegetation living within the pooled area nor are outfalls directed through vegetated areas prior to open water release. Nitrogen reduction is minimal, but phosphorus and sediment are reduced.

Along with the structural BMPs listed above, the urban sector is also providing treatment through non-structural measures. These are treatments that rely on programs that continue throughout the year. These were selected because there is the public will to adopt, they are cost effective, and have proven success in improving water quality. Urban Nutrient Management will be implemented on all urban pervious areas and will be initiated through public education as well as the regulations in the Sediment and Stormwater Regulations effective January 1, 2014.

- **Nutrient management —** Urban nutrient management involves the reduction of fertilizer to grass lawns and other urban areas. The implementation of urban nutrient management is based on public education and awareness, targeting suburban residences and businesses, with emphasis on reducing excessive fertilizer use. This does not account for the recent laws passed to remove P from fertilizer. As an added margin of safety providing reasonable assurance that fertilizer will be appropriately managed in the urban and suburban environment, a voluntary program known as Delaware Livable Lawns, administered through the Delaware Nursery and Landscape Association, has been developed to provide education, outreach, and certification for suburban fertilizer use and certification of lawn care companies. The Delaware Livable Lawns Program is a voluntary homeowner education and commercial lawn-care certification program.
- **Street sweeping**. —Street sweeping should occur twice a month or 26 times a year on urban streets. This frequent sweeping of the same street will reduce nitrogen and phosphorus as well as sediment. DelDOT is planning to track sweeping by incorporating GPS into the sweepers.
- **Erosion and sediment control**. —These measures are implemented on construction sites to mitigate erosion. Construction areas are one of the critical areas with a high recovery potential. Delaware's Sediment and Stormwater Program is currently managed by the Division of Watershed Stewardship in the Department of Natural Resources and Environmental Control. The existing Delaware Sediment and Stormwater Regulations require erosion and sediment control during construction and post-construction for water quality. The DSSR effectively cover the entire development process, from the time construction begins, through project completion, and permanent maintenance of stormwater management facilities. Unless specifically exempted, any proposed land development project that disturbs more than 5,000 square feet must comply with the DSSR. The DSSR are effective Statewide, and are applicable for new development, redevelopment, MS4s and non-MS4s. In order to comply with these regulations, projects must employ stormwater Best Management Practices (BMPs) to address both water quality as well as water quantity impacts. The Sediment & Stormwater Management Plans are vigorously reviewed by local delegated agencies and are only approved if it is deemed that they meet minimum State-wide regulatory requirements. These delegated agencies also ensure these approved plans are constructed properly in the field through a process of frequent

inspections on a regular basis that ensures regulatory compliance with the DSSR that includes a final inspection and close-out process. The penalty section of the DSSR provides DNREC with the authority to pursue both civil and criminal actions should enforcement for non-compliance be necessary. The delegated agencies responsible for enforcing these regulations and their areas of responsibility are included in the Final Phase 2 CBWIP 03301012A on pages 76-77.

Table 9 compares the implementation for existing BMPs with the planned levels of implementation. Note the substantial increase in erosion and sediment control. This BMP is prioritized because it targets the loads from construction, a major source of pollution. The focus on urban nutrient management is possible because of the number of acres available to apply this practice to. This increase in implementation will achieve the loads shown in Table 6 These loads exceed the TMDL required reductions for the Chester/Choptank.

Table 9: Urban BMP implementation, actual 2012 and planned levels for the Chester/Choptank.

Urban Practice	Units	2012 Actual Implementation	Planned Implementation
Chester River			
Bioretention	acres	0	0.02
BioSwales	acres	0	0.02
Erosion and Sediment Control	acres	0	11.33
Extended Dry Ponds	acres	25	55.49
Filtering Practices	acres	0	0.01
Infiltration	acres	0	0.01
Street Sweeping	acres	0	114.34
Urban Nutrient Management	acres	0	1,165.65
Wet Ponds and Wetlands	acres	45	16.80
Choptank River			
Bioretention	acres	0	0.05
Bioswales	acres	16.67	21.07
Erosion and Sediment Control	acres	41.74	22.67
Extended Dry Ponds	acres	264.17	88.47
Filtering Practices	acres	16.08	15.78
Infiltration	acres	0	0.03
Street Sweeping	acres	0	302.65
Urban Nutrient Management	acres	0	3,121.70
Wet Ponds and Wetlands	acres	365.21	277.01

The measured effectiveness for each of these practices may be found in Table 10.

Table 10: Urban BMP effectiveness

BMP	Nitrogen Effectiveness (%)	Phosphorus Effectiveness (%)
Bioretention	70	75

BMP	Nitrogen Effectiveness (%)	Phosphorus Effectiveness (%)
Bioswale	70	75
Erosion and Sediment Control	25	40
Extended Dry Ponds	20	20
Filtering Practices	40	60
Infiltration	85	85
Nutrient Management	17	22
Street Sweeping	3	3
Wet Ponds and Wetlands	20	45

5.1.3 Agriculture

The agricultural sector is planning to make use of 22 BMPs to reduce nitrogen and phosphorus loads. The use of the existing practices will be expanded and in some cases refocused. Several new practices will be added to the suite of existing practices to more effectively target cropland loads. The cropland loads were among the highest loading land uses and have a high recover potential. Therefore, many of the BMPs were selected because they target cropland. These BMPs include continuous no-till, nutrient management planning, cover crops, buffers and wetland restoration. Another major source of pollution is from animal production areas. Manure control BMPs were selected to target this source of pollution. Each BMP included in this plan was evaluated to ensure that it met the following three criteria: 1) effectiveness for water quality improvement, 2) willingness among the public to adopt, and 3) implementable in a variety of types of operations. These practices are consistent with those identified in the Upper Chesapeake Tributary Action Team Pollution Control Strategy Recommendations of January 31, 2008. The entire suite of planned and existing practices includes:

- **Alternative Crops**—Alternative crops is a BMP that accounts for those crops that are planted and managed as permanent, such as warm season grasses. This functions as a conversion of the Watershed Model land uses that are cropland to the hay land use.
- **Alum**—Surface application of alum, an acidifier, to poultry litter to acidify poultry litter and maintain ammonia in the non-volatile ionized form (ammonium). This reduces atmospheric deposition of ammonia.
- **Animal Waste Management System**—Practices designed for proper handling, storage, and utilization of wastes generated from confined animal operations. Reduced storage and handling loss is conserved in the manure and available for land application.
- **Barnyard Runoff Control**—Includes the installation of practices to control runoff from barnyard areas. This includes practices such as roof runoff control, diversion of clean water from entering the barnyard and control of runoff from barnyard areas. Different efficiencies exist if controls are installed on an operation with manure storage or if the controls are installed on a loafing lot without manure storage.
- **Conservation Tillage** —Conservation tillage requires: (a) a minimum 30% residue coverage at the time of planting, and (b) a non-inversion tillage method.
- **Continuous No Till**—The Continuous No-Till (CNT) BMP is a crop planting and management practice in which soil disturbance by plows, disk or other tillage equipment is eliminated. CNT involves no-till methods on all crops in a multi-crop, multi-year rotation. When an acre is reported under CNT, it will not be eligible for additional reductions from the implementation of other practices such as cover crops or nutrient management planning. Multi-crop, multi-year rotations on cropland are eligible. Crop residue should remain on the field. Planting of a cover

crop might be needed to maintain residue levels. The system must be maintained for a minimum of five years. All crops must be planted using no-till methods.

- **Cover Crop** —A winter crop planted at a specified time with a specified seeding method. The crop may be neither fertilized nor harvested. A commodity cover crop may be harvested.
- **Cropland Irrigation Management**—Cropland under irrigation management is used to decrease climatic variability and maximize crop yields. The potential nutrient reduction benefit stems not from the increased average yield (20-25%) of irrigated versus non-irrigated cropland, but from the greater consistency of crop yields over time matched to nutrient applications. This increased consistency in crop yields provides a subsequent increased consistency in plant nutrient uptakes over time matched to applications, resulting in a decrease in potential environmental nutrient losses. The current placeholder effectiveness value for this practice has been proposed at 4% TN, 0% TP and 0% TSS, utilizing the range in average yields from the 2002 and 2007 NASS data for irrigated and non-irrigated grain corn as a reference. The proposed practice is applied on a per acre basis, and can be implemented and reported for cropland on both lo-till and hi-till land uses that receive or do not receive manure.
- **Decision Agriculture**—A management system that is information and technology based, is site specific and uses one or more of the following sources of data: soils, crops, nutrients, pests, moisture, or yield for optimum profitability, sustainability, and protection of the environment. This BMP is modeled as a land use change to a nutrient management land use with an effectiveness value applied to create an additional reduction. It is intended to be more effective than regular nutrient management.
- **Forest Buffers**—Agricultural riparian forest buffers are linear wooded areas along rivers, streams and shorelines. Forest buffers help filter nutrients, sediments and other pollutants from runoff as well as remove nutrients from groundwater. The recommended buffer width for riparian forest buffers (agriculture) is 100 feet, with a minimum width of 35 feet required.
- **Grass Buffers; Vegetated Open Channel** —Agricultural riparian grass buffers are linear strips of grass or other non-woody vegetation maintained between the edge of fields and streams, rivers or tidal waters that help filter nutrients, sediment and other pollutants from runoff. The recommended buffer width for riparian forests buffers (agriculture) is 100 feet, with a minimum width of 35 feet required. Vegetated open channels are modeled identically to grass buffers.
- **Land Retirement to hay without nutrients (HEL)** —Converts land area to hay without nutrients. Agricultural land retirement takes marginal and highly erosive cropland out of production by planting permanent vegetative cover such as shrubs, grasses, and/or trees. Agricultural agencies have a program to assist farmers in land retirement procedures.
- **Land Retirement to pasture (HEL)** —Converts land area to pasture. Agricultural land retirement takes marginal and highly erosive cropland out of production by planting permanent vegetative cover such as shrubs, grasses, and/or trees. Agricultural agencies have a program to assist farmers in land retirement procedures. acres
- **Mortality Composters**—A physical structure and process for disposing of any type of dead animals. Composted material land applied using nutrient management plan recommendations.
- **Nutrient Management**—Nutrient management plan (NMP) implementation (crop) is a comprehensive plan that describes the optimum use of nutrients to minimize nutrient loss while maintaining yield. A NMP details the type, rate, timing, and placement of nutrients for each crop. Soil, plant tissue, manure and/or sludge tests are used to assure optimal application rates. Plans should be revised every 2 to 3 years.
- **Off Stream Watering without Fencing**—This BMP requires the use of alternative drinking water sources away from streams. The BMP may also include options to provide off-stream shade for

livestock, and implementing a shade component is encouraged where applicable. The hypothesis on which this practice is based is that, given a choice between a clean and convenient off-stream water source and a stream, cattle will preferentially drink from off-stream water source and reduce the time they spend near and in streams and streambanks. Alternative watering facilities typically involves the use of permanent or portable livestock water troughs placed away from the stream corridor. The source of water supplied to the facilities can be from any source including pipelines, spring developments, water wells, and ponds. In-stream watering facilities such as stream crossings or access points are not considered in this definition. The modeled benefits of alternative watering facilities can be applied to pasture acres in association with or without improved pasture management systems such as prescribed grazing or precision intensive rotational grazing.

- **Poultry Phytase** —Phytase is an enzyme added to poultry-feed that helps poultry absorb phosphorus. The addition of phytase to poultry feed allows more efficient nutrient uptake by poultry, which in turn allows decreased phosphorus levels in feed and less overall phosphorus in poultry waste.
- **Soil Conservation and Water Quality Plans**—Farm conservation plans are a combination of agronomic, management and engineered practices that protect and improve soil productivity and water quality, and to prevent deterioration of natural resources on all or part of a farm. Plans may be prepared by staff working in conservation districts, natural resource conservation field offices or a certified private consultant. In all cases the plan must meet technical standards.
- **Stream Restoration** — Stream restoration is used to restore the urban stream ecosystem by restoring the natural hydrology and landscape, Restoration also helps improve habitat and water quality conditions in degraded streams by reducing erosion and sedimentation.
- **Tree Planting**—Tree planting includes any tree planting, except those used to establish riparian forest buffers, targeting lands that are highly erodible or identified as critical resource areas.
- **Upland precision intensive rotational grazing**— This practice utilizes more intensive forms pasture management and grazing techniques to improve the quality and quantity of the forages grown on pastures and reduce the impact of animal travel lanes, animal concentration areas or other degraded areas of the upland pastures. PIRG can be applied to pastures intersected by streams or upland pastures outside of the degraded stream corridor (35 feet width from top of bank). The modeled benefits of the PIRG practice can be applied to pasture acres in association with or without alternative watering facilities. They can also be applied in conjunction with or without stream access control. This practice requires intensive management of livestock rotation, also known as Managed Intensive Grazing systems (MIG), that have very short rotation schedules. Pastures are defined as having a vegetative cover of 60% or greater.
- **Water Control Structures**—Installing and managing boarded gate systems in agricultural land that contains surface drainage ditches.
- **Wetland Restoration**—Agricultural wetland restoration activities re-establish the natural hydraulic condition in a field that existed prior to the installation of subsurface or surface drainage. Projects may include restoration, creation and enhancement acreage. Restored wetlands may be any wetland classification including forested, scrub-shrub or emergent marsh.

Agricultural areas will add these new BMPs to the suite of BMPs currently used to control pollution: alternative crops, continuous no-till, crop irrigation management, decision agriculture, land retirement to pasture, stream restoration, grazing practices, and water control structures. These new BMPs, in combination with refocusing existing BMPs will reduce the loads to the Bay TMDL allocations. Table 11 compares the implementation for existing BMPs and the planned levels of implementation. This increase in implementation will achieve the loads shown in Table 7. These loads are equivalent to or exceed the TMDL allocations for the Chester/Choptank watershed. The Tributary Action Team identified water control structures in tax ditches as well as cover crops. The NRCS cost-shared practices that are prioritized include buffers, wetland restoration, continuous no till, nutrient management plans and phytase.

Table 11: Agricultural BMP implementation, 2012 actual and planned levels, for each of the subwatersheds within the Chester/Choptank.

Agricultural Practices	Units	2012 Actual Implementation	Planned Implementation
Chester River			
Alternative Crops	acres	0.00	78.53
Alum	percent	50.00	0.00
Animal Waste Management Systems	animal units	904.29	1,831.33
Barnyard Runoff Control	acres	0.29	8.83
Conservation Tillage	acres	4,584.02	6,963.23
Continuous No Till	acres	0.00	11.14
Cover crops	acres	3,201.10	3,920.26
Crop irrigation management	acres	0.00	6,318.08
Decision Agriculture	acres	0.00	16,262.20
Forest Buffers	acres	33.40	279.89
Grass Buffers	acres	32.45	370.00
Land Retirement to hay without nutrients	acres	142.56	229.32
Land Retirement to Pasture	acres	0.00	32.97
Mortality Composting	animal units	133.84	106.78
Nutrient Management	acres	9,077.77	361.82
Off stream watering without fencing	acres	44.58	20.17
Poultry Phytase	animal units	all poultry	all poultry
Soil and Water Conservation Plans	acres	6,871.83	9,183.26
Stream Restoration	miles	0.00	0.57
Tree Planting	acres	1.25	44.11
Upland Precision Intensive Rotational Grazing	acres	0.00	70.39
Water Control Structures	acres	0.00	722.12
Wetland Restoration	acres	412.79	517.46
Choptank River			
Alternative Crops	acres	0.00	236.95
Alum	percent	100.00	0.00
Animal Waste Management Systems	animal	3,072.80	6,320.62

Agricultural Practices	Units	2012 Actual Implementation	Planned Implementation
	units		
Barnyard Runoff Control	acres	0.82	25.08
Conservation Tillage	acres	13,919.56	20,789.94
Continuous No Till	acres	0.00	33.26
Cover crops	acres	7,441.66	11,697.52
Crop irrigation management	acres	0.00	18,595.83
Decision Agriculture	acres	0.00	48,452.89
Forest Buffers	acres	211.70	910.79
Grass Buffers	acres	137.32	1,074.85
Land Retirement to hay without nutrients	acres	289.36	276.30
Land Retirement to Pasture	acres	0.00	96.62
Mortality Composting	animal units	373.23	368.53
Nutrient Management	acres	26,832.48	977.49
Off stream watering without fencing	acres	135.09	53.55
Poultry Phytase	animal units	all poultry	all poultry
Soil and Water Conservation Plans	acres	23,697.77	26,714.29
Stream Restoration	miles	0.00	1.65
Tree Planting	acres	4.33	128.12
Upland Precision Intensive Rotational Grazing	acres	0.00	186.84
Water Control Structures	acres	0.00	2,398.62
Wetland Restoration	acres	1,050.02	1,595.92

*Nutrient management has historically been reported at 100% in DE. DE is working through a process of adapting their tracking to more accurately reflect implementation. Therefore, a reduction from 2012 represents only a correction in data.

The measured effectiveness for each of these practices may be found in Table 12.

Table 12: Agricultural BMP effectiveness

BMP	Nitrogen Effectiveness	Phosphorus Effectiveness
Alternative Crops	Land use change to a lower loading land use	
Alum	Applied as a change in the manure load on the production area	
Animal Waste Management Systems	Applied as a change in the manure load on the production area	
Barnyard Runoff Control	20	20
Conservation Tillage	Land use change to a lower loading land use	
Continuous No Till	10-15	20-40

BMP	Nitrogen Effectiveness	Phosphorus Effectiveness
Cover Crop (effectiveness varies depending on variety, plant date, and plant method and if it is commodity or not)	5-45	0-15
Cropland Irrigation Management	4	0
Decision Agriculture (land use change to nutrient management plus efficiency)	3.5	0
Forest Buffers (land use change plus efficiency)	0-65	0-45
Grass Buffers; Vegetated Open Channel - Agriculture	Land use change to a lower loading land use	
Land Retirement to hay without nutrients (HEL)	Land use change to a lower loading land use	
Land Retirement to pasture (HEL)	Land use change to a lower loading land use	
Mortality composting	Applied as a change in the manure load	
Nutrient Management	Land use change to a lower loading land use	
Off Stream Watering Without Fencing	5	8
Poultry phytase	Applied as a change in the concentration of phosphorus in manure	
Soil Conservation and Water Quality Plans	3-8	5-15
Stream Restoration	Load Reduction-not modeled with an effectiveness value	
Tree Planting	Land use change to a lower loading land use	
Upland precision intensive rotational grazing	9-11	24
Water Control Structures	33	0
Wetland Restoration (land use change plus efficiency)	7-25	12-50

To provide added assurance of BMP effectiveness, Delaware has instituted a comprehensive Nutrient Management Law that controls the minimum set of management practices that are included in nutrient management plans. In regard to phosphorus in soils, it is important to note that Delaware's NMP's are p-based and have been for many years. The application of phosphorus is limited on high phosphorus soils, and utilizes a three year crop removal policy to restrict phosphorus application in certain conditions on high phosphorus soils. High phosphorus soils are determined based on the Phosphorus-Site Index analysis. In the absence of phosphorus data, yield based assessments are conducted using the four highest yield goals out of the last seven years. In addition to the phosphorus and nitrogen limiting plans, Delaware has a manure relocation program aimed at reducing phosphorus in soils. To obtain appropriate agronomic rates for application of manure, biosolids, and organic byproducts, the Nutrient Management Plan incorporates soil testing, manure testing, phosphorus index, and crop needs. Delaware allows three and one year NMPs, with the majority being one year plan. In addition, feedback from NMP writers indicates that most Delaware's producers and NM Consultants are utilizing yearly soil test data regardless of plan length. Additional information on the enforcement of this law is specified in the Final Phase 2 CBWIP 03301012A beginning on page 154.

5.1.4 Septic

The Department's Ground Water Discharges Section is developing revisions to its statewide onsite wastewater disposal regulations. The proposed changes would require new or replacement systems within 1,000 feet of tidal waters and associated tidal wetlands to comply with a 20mg/l limit for Total Nitrogen. There are no additional performance requirements for individual septic systems proposed in the regulations. Under the proposed regulations, all larger onsite wastewater treatment systems would be required to meet a performance standard based on the system size, age, and location.

Individual OWTDS are required by permit conditions to have the septic tank pumped out once every three years. Any OWTDS with a design flow of 2,500 gpd and above are required by the current Regulations Governing the Design Installation and Operation of On-site Wastewater Treatment and Disposal Systems to have a licensed operator to oversee operations of the OWTDS, and submit compliance reports with monitoring data on a routine basis as established in the operating permit. All OWTDS's with a design flow of 2,500 gallons per day or greater are issued individual operating permits with a maximum 5-year term. The On-Site Regulations are currently open for review and several modifications resulting in increased nutrient reduction are being proposed on a state-wide basis. Penalties for noncompliance include but are not limited to: voluntary compliance agreements, verbal warning, manager's warning letter, non-compliance notifications, Notice of Violation (NOV), and Secretary Order, which could include fines. For voluntary and/or incentive-based programs identified in the WIP as currently controlling nutrient and sediment loads, programs verify that controls are installed and maintained through Department inspections and monitoring data (effluent, ground water, and soils). Repercussions and penalties for false reporting or improper installation or maintenance of voluntary practices are listed under chapter 60 DE code. Fines can be as high as $10,000 a day.

A three-fold approach to reducing nitrogen loss from septic systems is planned: 1) upgrades, 2) pump-outs, 3) connections. Systems within 1,000 feet of tidal waters and associated tidal wetlands will be upgraded to advanced treatment (septic denitrification) technologies. More frequent septic pump-outs are also being required. Septic pumping will be increased from 23 in 2012 to 3,019 by 2025. Lastly, Delaware is planning to connect 632 systems to a wastewater treatment plant by 2025.

5.1.5 Forest

The Forest Service has identified ways to better sustain the forests in Delaware. In terms of water quality, an increase in forest buffers is planned. In 2012, Delaware had 245 acres of forest buffers which will be increased to 1,191 acres, allowing Delaware to meet its nitrogen, phosphorus and sediment allocation. Tree planting will also increase from 6 acres in 2012 to 172 acres by 2025. Wetland restoration will increase from 1,463 in 2012 to 2,113 in 2025.

5.2 Bacteria

This Watershed Management Plan recommends multiple BMPs that are able to reduce bacteria through impressive removal efficiencies (Table 13). Some of these are also used to control nutrients, and the nutrient removal efficiencies are referenced in the appropriate nutrient source sector section.

Table 13: BMP Bacteria Removal Efficiencies and Source Sector Treated

BMP	Removal Efficiency	Source Sector Treated
Streamside Fencing[1]	100%	Agriculture
Improved Pasture Management[1]	50%	Agriculture
Conservation Tillage[1]	61%	Agriculture
Repaired Septic System[1]	100%	Septic
Rain Garden[1]	85%	Urban

Sand Filters[2]	36% - 83%	Urban
Biofiltration[2]	>99%	Urban
Pet Waste Control Program[1]	75%	Urban/Agriculture
Retention Pond[2]	44% - 99%	Urban/Agriculture
Vegetated Buffer[2]	43% - 57%	Urban/Agriculture
Constructed Wetlands[2]	78% - 90%	Urban/Agriculture/Forest

1. MapTech, Inc., "Fecal Bacteria and General Standard TMDL Implementation Plan Development for Back Creek". 2006.
2. Allison Boyer, DNREC. "Reducing Bacteria with Best Management Practices".

Manure is the dominant source of bacteria in these highly agricultural watersheds. Preventing manure from entering the waterways is in primary strategy for reducing bacteria. Septics are also a substantial source of bacteria and can be treated by septic system maintenance and replacement.

Based upon the source assessment and BMP data, it is our assumption that bacteria reductions are being met throughout the Chester/Choptank. DNREC will work with EPA to track bacteria load reductions from BMPs that are implemented.

5.3 Offsetting Nutrient and Sediment Loads from Future Growth

Delaware has determined that an offset program is a cost-effective means of controlling new or increased loads. "Offset" means an alternate to strict adherence to the regulations including, but not limited to trading, banking, fee-in-lieu, or other similar program that serves as compensation when the requirements of these regulations cannot be reasonably met on an individual project basis.

Delaware established Sediment and Stormwater Regulations that became effective January 1, 2014. These regulations provide for an offset program with three options to offset new and increased loads:

1. Revised stormwater regulations
2. Stormwater in-lieu fee if site constraints prevent achievement of water quality goals on a specific parcel
3. Offsetting residual nutrient loads on another site within the same basin.

5.3.1 Statewide Stormwater Regulations

The Department's Sediment and Stormwater Program implemented new statewide stormwater regulations in 2013, see Chapter 7 of the regulations. The new regulations contain the following language: Stormwater in-lieu fee: Working with the Center for Watershed Protection, Delaware's Sediment and Stormwater Program has developed a "common currency" for all shortfalls equivalent to the cost of treating unmanaged runoff volume. The cost of $23 per cubic foot of runoff volume is based on land acquisition, construction and maintenance costs for unmanaged volume.

5.3.2 Establish in-lieu fee for stormwater impacts

Under current state law, the Department has the authority to establish an in-lieu fee for erosion and sediment control. The Sediment and Stormwater Program will determine which entities may collect the fees, how the fees would be collected and spent, and how projects would be prioritized and implemented. Programs may be operated and money spent at the local government or conservation district level under guidelines established by DNREC. The Department will also determine specific uses for the in-lieu fee.

5.3.3 Establish a statewide program that provides additional flexibility for offsets

Delaware's Sediment and Stormwater Regulations establish a state-wide program for offsets. EPA is currently preparing Technical Memorandums that will inform the development of this program.

Additional information on development of offset approaches is specified in the Final Phase 2 CBWIP 03301012A beginning on page 140.

5.3.4 Adaptive management

Adaptive management is a critical component of achieving any TMDL and this Watershed Management plan. The two-year milestones provide interim planning targets. These are reevaluated against progress and revised to ensure that Delaware is on track to meet its goals. Progress is evaluated on an annual basis through the Chesapeake Bay Program annual review. All BMPs implemented everywhere by all people are tracked and reported.

The CAST tool is an online model that allows for immediate pollutant load estimations based on the BMPs implemented. The output is the pounds of nutrients and sediment at the edge-of-stream. These water quality indicators allow managers to determine if the BMP implementation is successful, or needs to be adapted. This tool allows for adaptions to the plans based on changes in implementation levels. This tool is more fully described at the beginning of this section. In addition, Section 9 provides additional detail about evaluating load reductions.

Moreover, the Chesapeake Bay Program provides loads for each watershed to assess how much progress is made annually. This information is used to modify the milestones. There also is a mid-point assessment scheduled for 2017. At this time, multiple lines of evidence including: several models, monitoring data, and the most recent science on BMP effectiveness and water quality response will be evaluated by the Chesapeake Bay Program Partnership. The milestones, progress, mid-point assessment and annual progress review all contribute to constant reassessment of management plans, and adapting responses accordingly. Coordination and participation with the Chesapeake Bay Program Partnership is a priority for Delaware. Delaware has members who currently serve as the lead on an expert panel evaluating poultry litter, chair of the Water Quality Goal Implementation Team, and are represented on at least 10 other workgroups, at last count. This participation is critical to Delaware because it is the work of the Bay Program that provides the resources for projecting loads under different management actions and the coordination of science that supports the management decisions critical to reducing nitrogen, phosphorus and sediment pollution.

5.4 Summary

The practices and implementation levels proposed here meet the Chester and Choptank TMDL required reductions for nutrients and bacteria. The management measures outlined in this section are well within the capacity of Delaware to administer given existing funding programs, public will, and systems in place. These management measures have been reported to the Chesapeake Bay Program through a National Environmental Information Exchange Network (NEIEN) network node. Delaware also tracks implementation on various other tools, all of which feed data to NEIEN in the appropriate format. This tracking ability allows Delaware to nimbly refocus efforts and funding resources where implementation is not proceeding as planned. New technologies are continuously evaluated to determine if the new technologies allow more efficient or effective pollution control.

6 Technical and Financial Assistance Needs (d)

Technical Needs

Technical assistance to meet the reductions and goals of the WIP takes on many forms including DNREC assistance to local governments, state and local partner assistance to both DNREC and municipalities, and technical consultants contracted to provide support across a wide variety of service areas related to WIP planning and implementation.

DNREC has and will provide technical assistance to local governments through training, outreach and tools, including recommendations on ordinance improvements, technical review and assistance for implementation of best management practices at the local level, and identification of potential financial resources for implementation (DWIC, 2012).

DNREC has many partners that provide outreach to homeowners and communities in the form of technical assistance, education, and funding for implementation of best management practices within local communities. Partners include, but are not limited to the Delaware Nature Society, Delaware Forest Service, University of Delaware Cooperative Extension, Sussex Conservation District, Kent Conservation District, New Castle Conservation District, Master Gardeners/Cooperative Extension Service, Delaware Center for Horticulture. These partners provide all levels of support for various programs (DWIC, 2012).

Consultants can be contracted to provide a variety of technical services. For example, Tetra Tech has provided the Local Governments with a review of local ordinances along with a set of recommendations for consideration as they review and update ordinances. Tetra Tech has also provided model ordinances for consideration. State and local governments can contract with consultants through standard means, or through grant and funding assistance programs such as the National Fish and Wildlife Foundation's (NFWF) Technical Assistance Program. DNREC may also hire consultants to provide assistance.

Technical assistance for the Chester and Choptank watersheds can take all of these forms; however as the Chester and Choptank watersheds are primarily forested and agricultural, and with a majority of load reductions anticipated from the agricultural section (See Section 4), it follows that technical assistance to farmers will be a focus. Support from the University of Delaware Cooperative Extension, Kent County Conservation District, Delaware Department of Agriculture (DDA), Farm Service Agency (FSA) as well as federal assistance from the United States Department of Agriculture (USDA) Natural Resources Conservation District (NRCS) and Farm Services Agency (FSA). The DDA oversees Delaware's Nutrient Management Plan program. The state has recently updated the Nutrient Management Program State Technical Standards, and the DDA will facilitate technical assistance to develop and implement Nutrient Management Plans. In 2011, two Strategic Watershed Action Team (SWAT) planners were hired by the Sussex Conservation District as part of an agreement between the USDA - NRCS, DNREC-Division of Watershed Stewardship, and the Kent and New Castle Conservation Districts. The planners are stationed in the Sussex Conservation District office but have statewide responsibility in the Chesapeake Bay Watershed. The SWAT planners were hired to complete 112 Comprehensive Nutrient Management Plans (CNMP) in the watershed over the next two years.

Technical assistance for Public Participation and Education, and for Monitoring will also be necessary to fully implement and track progress towards meeting the goals of the WIP. These elements are discussed in sections 7 and 9 of this plan.

Financial Needs

The total projected cost to implement the management measures described in this plan for the Chester and Choptank watersheds is $50,028,479. Costs for capital and one-time expenses have been listed directly. For the programmatic management measures or additional staffing costs, annual costs have been converted to total costs by calculating the sum of all incremental costs from 2012 to the 2025 target. Table 14 below includes a summary of funding need per source sector. In this estimate, projected annual costs do not include current staff required for the various programs to implement programs. Anticipated BMPs and funding requirements for each sector are discussed in the sections below.

Table 14: Summary of Funding Needs per Source Sector

Source Sector	Total Cost	Total Cost Chester and Choptank Rivers[1]
Wastewater	$53,000,000	NA[2]
Urban	$3,392,000	$423,827
Agriculture	$233,374,880	$49,267,290
Septic	$2,700,000	$337,362
Forest	$0	$0
Total, 2013-2025	**$292,466,880**	**$50,028,479**

[1]Costs for urban, septic, and forest are proportional costs based on the Chester and Choptank acreage in relation to the total acreage of Delaware's Chesapeake Bay watersheds. Agricultural costs were calculated using EPA's Unit Costs of Agricultural Best Management Practices (BMPs) in Watershed Implementation Plans (WIPs) for the Chesapeake Bay Jurisdictions spreadsheet (last updated 4/2/2013).

[2]There are no WWTP, CSO, or Industrial facilities in these watersheds

6.1 Wastewater

There are no permitted WWTP, CSO, or Industrial facilities in the Chester and Choptank watersheds and as a result there is no requirement for funding improvements in this sector.

6.2 Urban

Within the Chesapeake Bay Watershed communities, DNREC has determined by analyzing land use patterns, that retrofits are not the solution to reduction of pollution loading. As a result, Delaware is not currently focusing efforts on structural stormwater retrofits due to their expense. Instead, stormwater funding is focused on building capacity to meet growing demands for source reduction strategies. These include GIS data management, tracking and reporting inspections, updating regulations, and training and outreach programs. They also include activities included under the Land Use category in the WIP, which involves developed areas. Detailed cost data per individual BMP and BMP type for the urban sector are not currently available for Delaware, as opposed to the agricultural sector which has a much more refined unit cost structure; therefore Table 15 shows the overall funding requirements for the urban sector pro-rated for the Chester and Choptank watersheds.

Table 15: Projected Funding Requirements, Urban Stormwater BMPs (2013-2025)

BMP	Total Cost	Proportional Total Cost Chester and Choptank
Projects		
GIS data management and system upgrades,	$5,000	$625
Revised regulations for industrial storm water management	$69,000	$8,621
New and revised technical standards and Regulations for Stormwater management practices	$315,000	$39,359
Additional training program for staff, permittee, and system owners and operators	$50,000	$6,247
Outreach to system owners and operators regarding new requirements	$50,000	$6,247
Urban retrofits inventory	$150,000	$18,742
Municipal urban storm water retrofit demonstration projects, at least one per community, ten communities	$200,000	$24,990
Develop nutrient offset regulations	$105,000	$13,120
Work with local governments to develop master plans	$252,000	$31,487
Annual Practices		
Additional maintenance inspections on storm water facilities in Kent and Sussex Counties	$1,440,000	$179,926
Staff to conduct increased number of industrial compliance inspections and enforcement	$756,000	$94,461
Manage nutrient offset program	$840,000	$104,957
Total, 2013-2025	$3,392,000	$423,827

6.3 Agriculture

Projected agricultural practices implemented within the Chester and Choptank watersheds from 2013 through 2025 are presented in Table 16. Overall, approximately $49,267,290 of funding is necessary for implementation, $46,022,158 of which will be needed for annual practices. Annual practice BMP total units and total cost represents all acres treated by strategies implemented and the cost of all strategies implemented from 2013 through 2025.

Table 16: Projected Funding Requirements, Agricultural BMPs (2013-2025)

BMP	Unit	Unit Cost	Total Units[1,2]	Total Cost - Chester and Choptank[2]
Animal Waste Management Systems	Animal units	$170	8,152.0	$1,383,393
Barnyard Runoff Control	Acres	$822	33.9	$27,889
Alternative Crops	Acres	$18	315.5	$5,770
Soil and Water Conservation Plans	Acres	$2	35,897.6	$71,135
Forest Buffers	Acres	$177	1,190.7	$210,526

BMP	Unit	Unit Cost	Total Units[1,2]	Total Cost - Chester and Choptank[2]
Grass Buffers	Acres	$189	1,444.9	$272,862
Land Retirement to hay without nutrients				
Land Retirement to Pasture	Acres	$169	635.2	$107,299
Stream Restoration	Linear feet	$7	11,704.2 (2.2 miles)	$78,926
Nutrient Management	Acres		1,339.3	-$1,219
Off stream watering without fencing	Acres	$30	73.7	$2,175
Tree Planting	Acres	$162	172.2	$27,859
Water Control Structures	Acres	$18	3,120.7	$55,396
Wetland Restoration	Acres	$475	2,113.4	$1,003,120
Annual Practices (2013 – 2025)				
Conservation Tillage	Acres	$13	386,743.5	$5,027,666
Continuous No-Till	Acres	$40	514.2	$20,566
Cover Crops	Acres	$52	143,649.7	$7,469,782
Crop Irrigation Management	Acres	$19	251,907.5	$4,803,036
Decision Agriculture-Nutrient Management	Acres	$30	881,555.4	$26,446,661
Mortality Composting (applied only to dead animals, not the total number of animals)	Animal units	$377	5,683.7	$2,143,722
Poultry Phytase	Animal units	-$51	Full Implementation	Full implementation costs
Upland Precision Intensive Rotational Grazing	Acres	$53	2,076.1	$110,725
			TOTAL COST, 2013 - 2025	**$49,267,290**

[1]Where "full implementation" is indicated, all animal manure or animals in the county are treated. Exact numbers of animals in the watershed are not reported because animal numbers are available only at the county scale, not the watershed scale. Total costs for these practices will be dependent on the number of animals treated.
[2]Annual practice BMP total units and total cost represents all acres treated by strategies implemented and the cost of all strategies implemented from 2013 through 2025.

6.4 Septic

The Chesapeake Bay WIP proposed several activities to reduce nutrient discharges from Onsite Wastewater Disposal Systems, including upgrades to failed systems, pumpouts, and connections to sewer systems. Funding for upgrades and maintenance is the responsibility of the system owner; however, there are additional annual costs required in order to increase inspections and manage the program. These are described in Table 17. The proportional total was derived from the proportion of developed land use in the Chesapeake Bay watersheds.

Table 17: Projected Funding Requirements, Onsite Wastewater BMPs (2013-2025)

BMP	Total Cost	Proportional Total Cost Chester and Choptank
Projects		
Outreach, staffing, and technical resources for permitting and inspection	$2,700,000	$337,362
Total, 2013-2025	**$2,700,000**	**$337,362**

6.5 Forest

Better management of forests in Delaware is the only management measure planned for the Chester and Choptank watersheds. The effort will be managed by existing personnel and no additional costs are foreseen.

6.6 Funding Sources

Funding required to implement the WIP in the Chester and Choptank watersheds would represent a fraction of the overall cost. There are cost savings associated with economies of scale by staffing for areas broader than the Chester and Choptank watersheds and also for program development that is statewide.

Funding for WIP implementation comes from sources including federal grants from EPA, USDA, and USFWS. Restoration funds are provided through grant programs such as the Chesapeake Bay Implementation Grant (CBIG) funded by the EPA, the National Fish and Wildlife Foundation (NFWF), and various agricultural cost share programs.

Examples of current funding sources are presented in Table 18.

Table 18: Summary of Sectors covered by Funding Sources

Funding Sources	Waste-water	Urban	Agricultural	Septic	Forest
Chesapeake Bay Implementation Grant (CBIG)		•	•		•
Chesapeake Bay Regulatory and Accountability Grant (CBRAP)			•		
National Fish and Wildlife (NFWF) Chesapeake Bay Stewardship Fund		•	•		•
Section 106 Grant		•	•		
Clean Water State Revolving Fund Program	•	•	•	•	•
Financial Assistance Branch of DNREC	•	•	•	•	•
The Delaware Nonpoint Source Program		•	•	•	•
Resource Conservation and Development Fund		•			
Non-Federal Administrative Account (NFAA)	•			•	
State of Delaware Conservation Cost Share			•		

Funding Sources	Waste-water	Urban	Agricultural	Septic	Forest
Program					
Delaware Conservation Reserve and Enhancement Program (CREP)			•		•
Delaware Nutrient Relocation			•		
Delaware Confined Animal Feeding Operations (CAFO)			•		
New Castle Conservation District Cost-Share Program			•		•
Delaware Nutrient Management Programs			•		
Federal USDA/NRCS Technical Assistance and Cost share programs					
Chesapeake Bay Watershed Initiative (CBWI)			•		•
Agricultural Management Assistance Program (AMA)			•		•
Wetland Reserve Program (WRP)			•		•
Wildlife Habitat Incentives Program (WHIP)			•		•
Environmental Quality Incentives Program (EQIP)			•		•
Conservation Reserve Program (CRP) – USDA and FSA			•		•

Two programs are noted here in more detail. The USDA/NRCS Chesapeake Bay Watershed Initiative (CBWI) through funding from the Food, Conservation, and Energy Act of 2008 (the 2008 Farm Bill) authorized the initiative and provided $23 million in 2009. Congress authorized additional funding levels of: $43 million in 2010; $72 million in 2011; and $50 million in 2012. The initiative is delivered through the Environmental Quality Incentives Program (EQIP). The Farm Bill is currently up for reauthorization.

The Kent Conservation District (KCD) Cost-Share Program provides cost-share funding, technical assistance, and outreach/educational services. The Cost-Share Program assists landowners and land managers to design and install site-specific conservation practices, for those agricultural BMP types approved by the KCD's Board of Supervisors, on their property within Kent County. The cost-share rates and limitations vary according to the practice; however cost-share rates range from 25-75%.

7 Public Participation / Education (e)

Delaware's Phase II WIP describes in great detail the outreach and education components that were employed for both Phases of the WIP development process, and provides recommended outreach strategies. Because the outreach is comprehensive and applies to similar pollutants, sources, and strategies between the Bay and local TMDLs, the process achieves the goals for outreach and education for both sets of TMDL regulations. The outreach completed to date as part of the WIP process is summarized here, with the most relevant outreach and education strategies to the Chester and Choptank watersheds.

The Chester River Association (CRA) and Midshore RIVERKEEPER® Conservancy (MRC) are quite active with full time staff, board members and an active membership. The CRA and MRC have public outreach campaigns in place including an Agricultural Outreach program and Youth Outreach as well as educational forums and newsletter distributions throughout the year. The groups are active in the community and will be the best first resource to implement public outreach and engagement campaigns in the Chester and Choptank watersheds.

In December 2010, the WIP Communications Team (WIPCT) was formed and membership was expanded from an informal team composed of staff from DNREC, DDA, and the USDA Delaware Office to include communications professionals from DNREC's Office of Planning, the Delaware Department of Transportation, and partner organizations – the Delaware Nature Society, Nanticoke Watershed Alliance, and the Delaware Home Builders Association. The goal was to communicate WIP efforts and develop communications and outreach materials.

The Team's role and responsibilities include:

- Develop key messages and education/outreach materials
- Support the education and outreach efforts of the WIP Subcommittees
- Develop a communications strategy and plan with measurable outcomes, focusing on the Delaware waterways of the Chesapeake watershed (and applicable to all of Delaware).
- Develop a watershed wide outreach program that encourages and inspires individuals to take actions for cleaner water.
- Maintain the flow of information and provide liaison between: Federal and state agencies; state and local governments; stakeholder groups; media outlets; collaborating agencies and organizations; and the general public.
- Strengthen and/or create partnerships with other agencies/stakeholders, public and private, and solicit Delaware volunteers from these partnerships (DWIC, 2012).

Public outreach during the development of the Phase I WIP included public meetings, forums and presentations with stakeholders and general public give opportunities to ask questions and voice concerns both during the meeting and following the meeting by submitting questions in writing. Forums and venues for the meetings included Town meetings (e.g. Blades, Dover, Seaford, Georgetown, Bridgeville), Conservation District Board meetings, the Positive Growth Alliance Board in Lewes, and the Nanticoke Tributary Action Team.

Outreach and education components continued during the Phase II WIP development, including preparation of fact sheets, brochures, posters, and frequently asked questions covering a wide range of WIP, water quality, and agricultural based topics. Press releases supplemented the outreach materials covering topics such as grant funding, CAFOs, stormwater regulations, and general water quality information. Public forums and workshops were held in addition to a full suite of special events aimed at raising general awareness, distributing rain barrels, providing information sharing and training among agencies and professionals, and reaching out to the agricultural community.

The DWIC identified many partners to assist in public participation and educational campaigns. The opportunities most relevant to the Chester and Choptank watersheds are outlined here. The Delaware Nature Society (DNS) is the pre-eminent non-profit environmental organization in the state. DNS is unique in the way it integrates education as a vital element in its role in preservation, conservation and advocacy. Currently thousands of members support this important work and/or participate in programs, while more than 1,000 volunteers assist the 32 member core staff and interns.

The DNS has extensive experience with education and outreach efforts, which will help inform residents, businesses and visitors of actions that they can take to improve water quality. While the focus of the DNS as reported in the Phase II WIP is on the Nanticoke Watershed, the statewide reach of the group makes it an attractive partner for Chester and Choptank programs. The DNS conducted a "Choose Clean Water" presentation to 80 attendees at a Middletown Town Council Meeting.

The DNS goals for 2012, included acquiring funding for the "We Choose Clean Water" campaign to:

- Build capacity for building the base of stakeholder support.
- Shape and promote local policy,
- Expand outreach to farmers, homeowners and businesses to increase adoption of best management practices,
- Initiate and actively manage on-the-ground implementation projects.

Additionally the group is expanding the Backyard Habitat ™ certification program in the Chesapeake Bay watershed which will:

- Educate the public about the connection of land use & water quality,
- Teach sustainable gardening practices to homeowners,
- Collect measurable data on nutrient reduction through the certification program.

These programs and others like them could be implemented in the Chester and Choptank watersheds.

In addition to the DNS, the following organizations have been identified for possible partnerships for WIP communications, education and outreach for the Chester and Choptank

- Master Gardeners
- Audubon Society
- Students for the Environment
- Delaware civic associations and service clubs in Chesapeake drainage areas:
  - Delaware Home Builders Assoc.
  - Alliance for The Chesapeake Bay, Inc.
  - Sierra Club – Delaware Chapter Coalition for Natural Stream Valleys, Inc.
  - Chester River Association
  - Chester River Water Quality Monitoring Program
  - Chesapeake Bay Foundation
  - Chesapeake Bay Trust
  - Choptank Watershed
  - Choptank Tributary Team
  - Friends of the Upper Choptank River
  - Delmarva Poultry Industry
  - Delmarva Power
  - Delaware Electric Cooperative
  - Delaware Farm Bureau
  - Nature Conservancy
  - AgroLab, Inc.
  - University of Delaware
  - Delaware State University
  - Delaware Technical and Community College

The Communications Subcommittee developed a Communications and Marketing Plan and initiated the Communications and marketing campaign in 2012. The goals of the campaign are to (1) to increase understanding by stakeholders and the general public of the need, value and regulatory elements of the WIP and (2) to increase voluntary changes in behavior that will support the overall plan goals. The Chester and Choptank area can tap into this resource and adapt programs and messaging as needed to reach out the general public, farmers, developers, policy-makers, legislators (local and national), businesses, educators, environmental groups, and non-profits.

The Communications and Marketing Campaign is seeking to include new messaging that will emphasize:

- Individual responsibility to improve water quality with targeting messaging
  - Responsibility relating to pesticide/fertilizer use
  - Responsibility relating to headwater forested areas

- Individual voluntary actions that will improve water quality in the watershed:
  - Installing rain gardens
  - Installing rain barrels
  - Creating permeable surfaces
  - Testing lawn chemistry and reducing lawn fertilizer and pesticides
  - Switching grass lawns to xeriscaping
  - Planting riparian buffers

Refer to Appendix A for a list of WIP communications updates as of January 28, 2014.

8 Implementation Schedule and Milestones (f & g)

This section presents the target loads and the activities required to achieve those targets based on milestones and the 2017 and 2025 interim and final loads and implementation targets. Load allocations and milestone targets for nutrients in the Chester and Choptank watersheds are based on the local TMDL (DNREC, 2005). Load allocations and milestone targets for Chester and Choptank sediment are based on the 2010 Chesapeake Bay TMDL (USEPA, 2010a). The following schedule and milestones follows Bay TMDL milestone date (60% progress by 2017) and end date (2025). This schedule has previously been approved by the CBP for the applicable Bay TMDLs.

8.1 Loading Allocations and Milestone Targets

The timeline for meeting the goals and commitments of both the Bay TMDL and the local TMDLs include reductions to meet interim and final loads in 2017 and 2025 respectively. The loading targets for nitrogen, phosphorus, and sediment for Delaware (DWIC, 2012) are presented here in Table 19.

Table 19: Interim and Final Nutrient / Sediment Loads from Delaware (Phase II WIP Planning Targets)

	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (lbs/yr)
2009 Load	4,474,253	345,140	98,946,818
2017 Interim Load (60% of 2025 load)	3,824,331	304,155	99,455,089
2025 Final Load	3,391,050	276,832	99,793,936

	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (lbs/yr)
Percent Reduction between 2009 and 2025	24%	20%	-1%

Milestone loads for 2013, planning loads for 2017, and final loads for 2025 for the Chester and Choptank watersheds are presented in Table 20 below. Milestones for 2015 will be developed in early 2014 but are not currently available for inclusion in this plan.

Table 20: Chester and Choptank Milestone, Planning, and Target Loads (lbs/yr) (delivered loads)

Watershed	Load	Nitrogen Load (lbs/yr)	Phosphorus Load (lbs/yr)	Sediment Load (lbs/yr)
Chester River	2009 Load	258,600	19,940	3,166,304
	2013 Milestone Load	141,272	8,516	2,371,816
	2017 Interim Load (60% of 2025 Load)	258,600	15,056	3,169,181
	2025 Final Load	258,600	11,800	3,171,098
Choptank River	2009 Load	496,400	46,390	6,092,838
	2013 Milestone Load	327,178	21,527	4,583,939
	2017 Interim Load (60% of 2025 Load)	496,400	35,188	6,111,221
	2025 Final Load	496,400	27,720	6,123,477

8.2 Implementation Milestones

To meet the loading allocations and milestones outlined in the previous section, implementation of programs and BMPs must keep pace and meet planned implementation targets. Table 21 details the implementation for each tracked BMP, segregated by urban and agricultural type with the associated unit of measure. The 2012 data reflects existing BMPs while the 2013 milestone data presents the planned levels of implementation as of 2013, as developed in 2011. The 2017, 2021, and 2025 values reflect the planned implementation for those years.

Table 21: Chester and Choptank Planning Milestones for Implementation

BMP	Unit	2012 Implemen-tation	2013 Milestone	2017 Planned	2021 Planned	2025 Planned[1]
Urban						
Bioretention with underdrains	acres	0	0.1	0.1	0.1	0.1
Bioswales	acres	16.7	21.1	21.1	21.1	21.1
Erosion and sediment control	acres	41.7	34.0	34.0	34.0	34.0
Extended detention dry ponds	acres	289.2	144.0	144.0	144.0	144.0
Filtering practices	acres	16.1	15.8	15.8	15.8	15.8

BMP	Unit	2012 Implemen-tation	2013 Milestone	2017 Planned	2021 Planned	2025 Planned[1]
Infiltration	acres	0	0	0	0.0	0
Street sweeping	acres	0	83.5	250.2	333.6	417.0
Urban Nutrient management	acres	0	857.5	2,572.4	3,429.9	4,287.4
Wet ponds or wetlands	acres	410.2	293.8	293.8	293.8	293.8
Agricultural						
Alternative crops	acres	0	68.6	197.6	252.4	315.5
Alum	percent	150.0	0	0.0	0.0	0
Animal Waste Management Systems	Animal units	3,977.1	3,175.3	5,223.7	6,521.6	8,152.0
Barnyard Runoff Control	acres	1.1	6.8	20.3	27.1	33.9
Conservation tillage	acres	18,503.6	28,899.1	28,517.1	28,135.2	27,753.2
Continuous No-till	acres	0	34.7	39.5	39.5	44.4
Cover Crops-all types	acres	10,642.8	4,844.8	8,478.4	12,494.2	15,617.8
Crop irrigation management	acres	0	13,841.1	19,377.5	19,931.1	24,913.9
Decision Agriculture	acres	0	70,908.8	68,844.2	66,779.7	64,715.1
Forest Buffers	acres	245.1	3,363.4	2,639.2	1,914.9	1,190.7
Grass Buffers	acres	169.8	1,474.6	1,464.7	1,454.8	1,444.9
Land Retire to hay without nutrients	acres	431.9	505.6	505.6	505.6	505.6
Land Retirement to pasture	acres	0	39.0	72.5	103.7	129.6
Mortality Composting	Animal units	507.1	321.1	475.3	475.3	475.3
Nutrient Management [2]	acres	35,910.3	1,358.0	1,338.10	1,339.3	1,339.3
Off stream watering without fencing	acres	179.7	17.0	51.0	59.0	73.7
Poultry Phytase	Animal units	Full imple-mentation	Full imple-mentation	Full imple-mentation	Full imple-mentation	Full imple-mentation
Soil conservation & water quality plans	acres	30,569.6	37,576.7	37,017.0	36,457.3	35,897.6
Stream Restoration	miles	0	0.4	1.3	1.8	2.2
Tree Planting	acres	5.6	34.4	103.3	137.8	172.2
Upland precision intensive rotational grazing	acres	0	62.2	164.2	205.8	257.2
Water Control Structures	acres	0	2,752.1	2,874.2	2,496.6	3,120.7
Wetland Restoration	acres	1,462.8	417.1	1,265.2	1,690.7	2,113.4
Forest						
Forest Harvest BML	acres	0	93.5	376.8	0	0

[1] Where "full implementation" is indicated, all animal manure or animals in the county are treated. Exact numbers of animals in the watershed are not reported because animal numbers are available only at the county scale, not the watershed scale.
[2]Nutrient management has historically been reported at 100% in DE. DE is working through a process of adapting their tracking to more accurately reflect implementation. Therefore, a reduction from 2012 represents only a correction in data.

8.3 Implementation Priorities

To meet the loading allocations and milestones outlined in the previous sections, implementation should be prioritized based on current 303(d) listings (i.e., categories 4a and 5) and TMDLs with highest priority given to listed segments located in headwaters. Impairments to headwater streams are carried and experienced downstream; therefore, improvements made to headwater streams will maximize the length of implementation impacts.

Stream segments that should be prioritized for implementation within the Chester and Choptank watersheds include the following (DNREC, 2012a):

- Tributaries of Chester River
    - Cypress Branch mainstem, including tributaries
    - Sewell Branch mainstem, including tributaries
    - Gravelly Run mainstem, including tributaries

- Tributaries of Choptank River
    - Tappahanna Ditch mainstem, including tributaries
    - Culbreth Marsh Ditch mainstem, including tributaries
    - Cow Marsh Creek mainstem, including tributaries

In addition, the *Upper Chesapeake Watershed Tributary Action Team Pollution Control Strategy Recommendations* (DNREC, 2008), which was developed to reduce nutrients draining to the Chester and Choptank Rivers, should serve as guidance for implementation efforts. The Tributary Action Team developed pollution control strategy recommendations within five main categories. Examples of some of the recommendations included in the Pollution Control Strategy are listed below.

- Reducing nutrients from existing development in watersheds
    - Identify areas where stormwater retrofits would effectively reduce nutrients
    - Educate Home Owners' Associations (HOAs) regarding stormwater BMP maintenance and management requirements and enforce requirements
    - Promote biennial pump outs of individual onsite wastewater treatment and disposal systems
    - Require a Nutrient Management Plan for any open space within a development
- Minimizing any increase as land use changes from agriculture to development
    - Require Low Impact Development (LID) in new construction and development
    - Require vegetated buffers of 20 feet beyond the end of the tax ditch management right-of-way for properties abutting waters in the watersheds following land changes from agriculture to developed land
- Addressing tax ditches
    - Installation and maintenance of sediment traps in tax ditches. Study the effectiveness in removing nutrients.

  - Require property owner to install fencing for animals outside of the tax ditch right-of-way
- Providing incentives for additional nutrient reductions from agriculture
  - Increase the funding for cost shares to allow an increase in the number of acres that can be planted in cover crops
  - Increase awareness of availability of cost share for water control structures
  - Increase the cost share for grassed filter strips and grassed waterways
- Education-based recommendations
  - Conduct tax ditch right-of-way education
  - Develop and implement a comprehensive homeowner education program for management of open spaces, yards, wastewater, and stormwater

For each pollution control strategy recommendation, the Tributary Action Team included the percent effectiveness for nitrogen and phosphorus load reductions (lbs/day), which may be used as supplemental guidance to rank implementation strategies. The team also noted where a particular recommendation is currently lacking load reduction information and where studies are needed.

9 Load Reduction Evaluation Criteria (h)

Progress evaluation will be measured through three approaches: tracking implementation of management measures, estimating load reductions through modeling, and tracking overall program success through long term monitoring.

Implementation will be measured by determining whether the targets for implementation shown in Table 21 are being met in according to the milestone schedule presented. For both urban and agricultural BMPs, the Watershed Assessment Section of DNREC currently collects this information annually.

Load reductions for the Chester and Choptank watersheds are estimated annually by the Chesapeake Bay Program using the Phase 5.3.2 Watershed Model. Updates are based on the information provided by DNREC described above. For purposes of comparison with TMDL target milestones, this is the most consistent method of estimating reductions, as the same model and input data are used. As an alternative for more frequent tracking, DNREC has the ability to generate loads and load reductions through CAST, which was created and is maintained by EPA. CAST is more fully described in Section 5 where the management measures are described.

Overall program success will be evaluated using trends identified through the long term monitoring program described below in Section 10. This includes the nitrogen/phosphorus local TMDLs in the Chester River and Choptank River, the Chesapeake Bay TMDL, and the bacteria TMDL.

TMDL compliance status will be evaluated to determine if the Watershed Management Plan needs to be updated. If the WLAs are revised during assessment of the overall Bay Program TMDL, the plan will be reevaluated and updated accordingly. If it is found during the evaluation of BMP implementation and load reductions that the milestone targets are not being met, a revision of the plan may be necessary.

Adaptive management is a critical component of achieving the Bay TMDL, local Chester and Choptank TMDLs, and this Watershed Management plan. The two-year milestones provide interim planning targets. These are reevaluated against progress and revised to ensure that Delaware is on track to meet its goals. Progress is evaluated on an annual basis through the Chesapeake Bay Program annual review. All BMPs implemented everywhere by all people are tracked and reported. The Chesapeake Bay Program provides loads for each watershed to assess how much progress is made annually. This information is used to modify the milestones. There also is a mid-point assessment scheduled for 2017. At this time, multiple lines of evidence including: several models, monitoring data, and the most recent science on BMP effectiveness and water quality response will be evaluated by the Chesapeake Bay Program Partnership. The milestones, progress, mid-point assessment and annual progress review all contribute to constant reassessment of management plans, and adapting responses accordingly. Coordination and participation with the Chesapeake Bay Program Partnership is a priority for Delaware. Delaware has members who currently serve as the lead on an expert panel evaluating poultry litter, chair of the Water Quality Goal Implementation Team, and are represented on at least 10 other workgroups, at last count. This participation is critical to Delaware because it is the work of the Bay Program that provides the resources for projecting loads under different management actions and the coordination of science that supports the management decisions critical to reducing nitrogen, phosphorus and sediment pollution.

9.1 Watershed Plan Tracker

The Delaware NPS Program will enter and track implementation actions (including the number of BMPs, BMP types, and associated costs) and load reductions can be performed using EPA's Watershed Plan Tracker (WPT) at the watershed scale to accommodate the diverse nature of information contained in the watershed plans. In addition, the WPT will track data by year, action, and individual pollutants. The WPT is embedded into the existing web-based national Grants Reporting and Tracking System (GRTS). Emphasis is placed on exploring and documenting the unique aspects and valuable assets of the watershed, adherence to EPA's watershed-based plan criteria introduces valuable standardization among the plans. This standardization enables the generation of a body of information for the impaired watershed that is in need of being restored to meet an acceptable water quality. To utilize this information as a management tool, and to make strategic planning decisions, the information, once entered into a database, can easily be reviewed and monitored for timely and effective decision-making.

10 Monitoring (i)

A robust and comprehensive monitoring program will be necessary to document that implemented strategies are having the desired effect and that water quality goals are being met. Water quality monitoring has provided evidence of changes in water quality and necessary data to develop models and TMDLs to meet the Clean Water Act goals for restoring the physical, chemical, and biological properties of the Delaware's waters. Monitoring will be needed to document changes as the Delaware and Chesapeake Bay TMDLs are implemented.

Delaware's Surface Water Quality Monitoring Program (DNREC, 2012b) is the primary program to be used in monitoring TMDL compliance. The program is used to calculate annual loads and determine water quality trends over time in major water bodies. Delaware follows a five-year rotating basin scheme to monitor all surface waters of the State. During every five-year cycle, each watershed within the State is monitored monthly for two years and every other month for the remaining three years.

As DNREC's 2012 statewide monitoring plan states, because monitoring budgets are limited, the numbers and locations of monitoring sites are being prioritized based on critical needs. Sites retained from previous years, or added as funding becomes available, fall into two categories:

- C1 – high priority monthly stations co-located with USGS gages for loading analysis and long term trends, generally positioned stations at the mouth of a tidal river
- C2 – stations monitored monthly or bi-monthly on a five-year rotating basis.

Surface waters of the State, including waters within the Chesapeake Bay Drainage, are monitored for a suite of 24 parameters including nutrients, bacteria, chlorophyll a, turbidity, organics, pH, dissolved oxygen, etc. It is estimated that water quality monitoring costs for the Chesapeake basin be about $110,000 for fiscal year 2011. For fiscal years 2012, 2013, and 2014 when monitoring frequency for most stations are reduced to every other month, the monitoring cost is estimated to be about $60,000. These estimates exclude monitoring for metals that occurs at some stations in the basin and also exclude quality control sampling and other monitoring plans and programs.

In 2012, there were five sites that were sampled six times in the Chester and Choptank watersheds. Sampling locations included one site in Chester River watershed (Sewell Branch) and four sites in the Choptank River watershed (Cow Marsh Creek, Tappahanna Ditch, Culbreth Marsh Ditch, and White Marsh Branch). These same sites were sampled 12 times in 2010 and 2011 with projected monitoring to continue at six times a year.

Analytical results from the stations are promptly published in the EPA STORET system and are available as part of the STORET network. More details for the Surface Water Quality Monitoring Plan (SWQMP) are available on DNREC's website.

Chesapeake Bay drainage was monitored as part of the five-year rotating basin program in 2010 and 2011 and will be sampled again in 2015 and 2016. There is an added complexity to monitoring these subwatersheds due to the MD and DE state border and the position of Delaware's drainage. The tidal receiving waters are located in Maryland, leaving no USGS gaging stations within the Delaware portion of the watershed on the smaller tributaries.

Citizen monitoring, as reported in the Phase II WIP is conducted by the DNS and the Nanticoke Watershed Alliance, however no programs specific to the Chester and Choptank are mentioned. The Chester River Association (CRA) runs a 'Chester Testers' program, monitoring both tidal and non-tidal waters; however, monitoring is currently occurring in the Maryland portion of the Chester River. Similar to monitoring conducted by the CRA, the Midshore RIVERKEEPER® Conservancy (MRC) also monitors water quality in the Maryland portion of the Choptank River. Monitoring in the Chester River and Choptank for the Bay TMDL should be coordinated with the CRA and MRC. In 2015, DNREC will reach out to these organizations to see if they would expand their monitoring into the Delaware portion of the Chester and Choptank Rivers.

11 References

CWP. 2003. Impacts of impervious cover on aquatic ecosystems. Center for Watershed Protection, Ellicott City, Maryland. 142p.

DNREC. "Bacteria Source Tracking & Bacteria TMDLs". Allison Boyer

DNREC. "Reducing Bacteria with Best Management Practices". Allison Boyer

DNREC. 2005. Total Maximum Daily Loads (TMDLs) Analysis for Chesapeake Drainage Watersheds, Delaware: Chester River, Choptank River, and Marshyhope Creek. Watershed Assessment Section, Division of Water Resources, Delaware Department of Natural Resources and Environmental Control. Dover, DE. http://www.dnrec.state.de.us/water2000/Sections/Watershed/TMDL/ChesDrainBasins_TMDLAnalyses_Final.pdf

DNREC. 2006. Total Maximum Daily Loads (TMDLs) Analysis for Chesapeake Bay Drainage Basin, Delaware: Chester River, Choptank River, Marshyhope Creek, Nanticoke River, Gum Branch, Gravelly Branch, Deep Creek, Broad Creek and Pocomoke River Watersheds. Watershed Assessment Section, Division of Water Resources, Delaware Department of Natural Resources and Environmental Control. Dover, DE.

DNREC. 2008. Upper Chesapeake Watershed Tributary Action Tem Pollution Control Strategy Recommendations. Delaware Department of Natural Resources and Environmental Control. Dover, DE.

DNREC. 2012a. State of Delaware 2012 Combined Watershed Assessment Report (305(b)) and Determination for the Clean Water Act Section 303(d) List of Waters Needing TMDLs. Delaware Department of Natural Resources and Environmental Control. Dover, DE.

DNREC. 2012b. State of Delaware Ambient Surface Water Quality Monitoring Program – FY 2012. Delaware Department of Natural Resources and Environmental Control. Dover, DE.

DNREC. 2013. Title 7 Natural Resources and Environmental Control, 5000 Division of Soil and Water Conservation. 5101 Sediment and Stormwater Regulations.

DWIC. 2010. Delaware's Phase I Chesapeake Bay Watershed Implementation Plan – November 29, 2010, prepared by Delaware's Chesapeake Interagency Workgroup

DWIC. 2012. Delaware's Phase II Chesapeake Bay Watershed Implementation Plan – March 30, 2012, prepared by Delaware's Chesapeake Interagency Workgroup.

KCCP. 2008. Kent County Comprehensive Plan – Adopted October 7, 2008

MapTech, Inc. "Fecal Bacteria and General Standard TMDL Implementation Plan Development for Back Creek". Dec. 2006.

Schueler, T. 1994. The importance of imperviousness. Watershed Protection Techniques, 1(3), 100-111.

State of Delaware. 2006a. Code 7412 TMDLs for the Chester River Watershed in Delaware – January 2006, State of Delaware

State of Delaware. 2006b. Code 7412 TMDLs for the Chester River Watershed in Delaware – January 2006, State of Delaware

State of Delaware. 2006c. Code 7430 TMDLs for Bacteria for the Chesapeake Bay Drainage Basin, Delaware –December 2006, State of Delaware

Upper Chesapeake Watershed Tributary Action Team. January 31, 2008. Upper Chesapeake Watershed Pollution Control Strategy Recommendations.

USEPA. 2010a. Chesapeake Bay Total Maximum Daily Load for Nitrogen, Phosphorus and Sediment, December 29, 2010. U.S. Environmental Protection Agency in collaboration with Delaware, the District of Columbia, Maryland, New York, Pennsylvania, Virginia, and West Virginia. Region 3 - Chesapeake Bay Program Field Office. Annapolis, MD. http://www.epa.gov/reg3wapd/tmdl/ChesapeakeBay/tmdlexec.html

USEPA. 2010b. Phase 5.3 Chesapeake Bay Watershed Model Documentation. U.S. Environmental Protection Agency, Region 3 Chesapeake Bay Program Office, Annapolis, MD.

Appendix A: WIP Communications – 2014

WIP Communications Updates from 3/1/12 to Present

Videos

- Water Quality Monitoring on the Nanticoke (Reach: 187 and counting)
- Septics 101 (Reach: 134 and counting)
- Managing Stormwater: Roads to Rivers (Reach: 78 and counting)
- Explore Your Nanticoke (Reach: 216 and counting)
- Monitoring the Murderkill with UD DNREC and Kent County Wastewater Treatment Facility (Reach: 283 and counting)
- Certified Wildlife Habitats (Reach: 338 and counting)
- Seaford Schoolyard Habitats (Reach: 438 and counting)
- What's a septic system got to do with it? (Currently shooting)

Social Media

- New Delaware Watersheds Facebook Account
- New Delaware Watersheds Twitter Account
- New Delaware Watersheds Quarterly Newsletter
- Email Blasts
- Social Media Releases
- New Social Media monthly promotion (Rain Barrel Giveaway)
- Race for Our Rivers Facebook page for event that DNREC will now be organizing

Events, Presentations and Demonstrations

- 2012 DOWRA's Annual Conference. Presentation on Septic Rehabilitation Loan Program (Reach: 300)
- 2012 Nanticoke Riverfest exhibit and demonstrations (Reach: 60)
- 2012 Ellendale Family Fun Day (Reach: 53)
- 2012 Coast Day (Reach: 1750)
- 2012 Delmarva Chicken Festival (Reach: 60)
- 2012 Delaware State Fair exhibit and demonstrations (Reach: 25,000)
- 2012 Event to highlight funds received by Greenwood, Bethel and Laurel from the National Fish and Wildlife Foundation for WIP related projects (Reach: 40)
- 2013 Nanticoke Riverfest exhibit and demonstrations (Reach: 200)
- 2013 DNREC Rain Barrel Sale and Tree Giveaway in New Castle (Reach: 90)
- 2013 DNREC Rain Barrel Sale and Tree Giveaway in Harrington (Reach: 90)
- 2013 DNREC Rain Barrel Sale and Tree Giveaway in Lewis (Reach: 90)
- 2013 Earth Day at R&R outreach event and rain barrel sale/presenting pledge campaign (Reach: 55)

- 2013 Nanticoke River Park Festival: Demonstrations on how to reduce stormwater runoff by building rain barrels, planting rain gardens, using pervious surfaces, creating certified wildlife habitats, etc. (Reach: 65)
- 2013 Delaware State Fair exhibit and demonstrations (Reach: 25,000)
- 2013 Race for Our Rivers (Reach: 75)

Workshops

- 2012 Kickoff of event/Workshop for Septic Rehabilitation outreach initiative. (Reach: 60)
- 2012 Septic Rehabilitation Loan Program Workshop at Coverdale Community Center in Bridgeville, DE (Reach: 24)
- 2012 Septic Rehabilitation Loan Program Workshop at Coverdale Community Center at Mt Joy Civic Association in Millsboro. (Reach: 22)
- 2012 Presentation to DOWRA's planning committee (Reach: 31)
- 2013 Presented information at a Nanticoke Watershed Alliance "Homeowners workshop" on DNREC's Septic Rehabilitation Loan Program and other efforts individuals can take to help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: 25)
- 2013 Nanticoke Watershed Alliance Rain Barrel Workshop: Presented information on DNREC's pledge campaign- Individuals pledge to take specific efforts to help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: 29)
- 2013 Nanticoke Rotary Club: Presented information on DNREC's video series as a resource for individuals looking for information pertaining to efforts that help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: 24)
- 2013 Local Govt. Workshop- Delaware's Chesapeake Bay Communities: Action Today for Tomorrow's Healthy Water: Topics include funding mechanisms for local governments; sources of grant funding; matching your project concept to potential funding sources; conceiving, organizing, and costing a project; grant writing tips. (Reach: 75)
- 2013 Sussex County Strong Communities Initiative Meeting: Presented information on DNREC's "Rain Barrel Building Workshop" opportunities and other information on reducing stormwater runoff. (Reach: 27)
- Spring and Twig Garden Club: Presentation on things people can do to reduce nutrient and sediment pollution

Promotional Materials

- 2012 Septic Rehabilitation loan program large display
- 2012 Septic Rehabilitation loan program mini display
- 2012 Septic Rehabilitation Loan Program brochure
- 2012 Septic Rehabilitation Loan Program lawn signs
- 2013 New WIP Messaging Branding Strategy developed: Delaware Watersheds brand and logo - to be used on new promotional materials and social media accounts, and for events.
- 2013 New homeowners brochure: An invitation to a healthy home and yard

- 2013 New mini display: An invitation to a healthy home and yard

Advertising

- 2012 radio advertising campaign for the Septic Rehabilitation Loan Program on WDSD 94.7
- 2012 Printed advertising campaign for the Septic Rehabilitation Loan Program: The Guide
- 2012 Printed advertising campaign for the Septic Rehabilitation Loan Program: Placemat advertising.
- 2013 Radio advertising for Septic Rehabilitation Loan Program: WDSD 94.7
- 2013 radio advertising for Septic Rehabilitation Loan Program: WXDE 105.9

WIP Committee/Subcommittee Meetings

- WIP Implementation team meets quarterly
- A WIP Communications Subcommittee meets quarterly with new partners being encouraged to attend and strengthening existing partnerships with groups such as the Nanticoke Watershed Alliance, the Delaware Nature Society, DelDOT, USDA, DE Forestry and DOA. The subcommittee is working to develop new branding strategies including a WIP mascot and slogan.
- Bi-weekly Chesapeake Bay staff meetings
- Monthly Chesapeake Bay Program Communications Workgroup meetings

Websites

- 2012 New webpage has been made to be used as an area where individuals, agriculture, businesses and organizations can find resources of information, support, and guidance for reducing nutrient and sediment pollution.
- New homepage for Watershed Stewardship (Release TBD)
- New webpage for Wetland Advisory Committee (Release TBD)
- 2013 Updates to Delaware Watersheds website
- 2013 Updates to partnering Delaware Invasive Species Council website
- 2013 Updates to Watershed Assessment and Management website

Television/Radio Interviews

- 2012 Interview by 94.7 WDSD: promotion of The Septic Rehabilitation Loan program (Reach: Delaware)
- 2013 Featured on WBOC TV's Delmarva Life discussing how individuals can help protect Delaware's waterways that lead to the Chesapeake Bay (Reach: Delmarva)
- 2013 DNREC Earth Day Event: Presented information to WBOC TV on DNREC's Septic Rehabilitation Loan Program, rain barrels, rain gardens, and other efforts individuals can take to help reduce nutrient and sediment pollution entering Delaware's waterways. (Reach: Delmarva)

Databases

- A database of available funding resources and sources for which various publics can apply has been compiled. The list is being updated continuously and will is available online and used in marketing materials and presentations.
- A database of brochures pamphlets and videos has been created, and a new webpage has been made to be used as an area where individuals, agriculture, businesses and organizations can find resources of information, support, and guidance for reducing nutrient and sediment pollution.

Pledge Campaign

- 180 pledges collected at events throughout the Chesapeake Bay Watershed
- Approximately 1,700 pledges collected at the 2013 Delaware State Fair

BMP Displays in Home Improvement stores

- How to build a rain barrel out of simple supplies from your local hardware store

Appendix B: State of Delaware Ambient Surface Water Quality Monitoring Program – FY 2012

State of Delaware Ambient Surface Water Quality Monitoring Program - FY 2012

Department of Natural Resources and Environmental Control Watershed Assessment Branch

Executive Summary

Delaware’s Surface Water Quality Monitoring Program for Fiscal Year 2012 is described in this report. Delaware maintains a General Assessment Monitoring Network (GAMN) of 134 stations. GAMN stations are considered long term stations whose data is used to do long term status and trend assessments of water quality conditions or the State’s surface waters and support compilation of Watershed Assessment Reports as mandated by the Clean Water Act under section 305(b). This plan implements an updated monitoring strategy that monitors 23 stations monthly, and the remaining stations either 6 or 12 times a year on a rotating basin basis. Some stations in selected watersheds are monitored for the dissolved forms of key metals in the water column.

Ambient Surface Water Quality Monitoring Program - FY 2012

The purpose of the Ambient Surface Water Quality Monitoring Program is to collect data on the chemical, physical and biological characteristics of Delaware's surface waters. The information that is collected under this Program is used to:

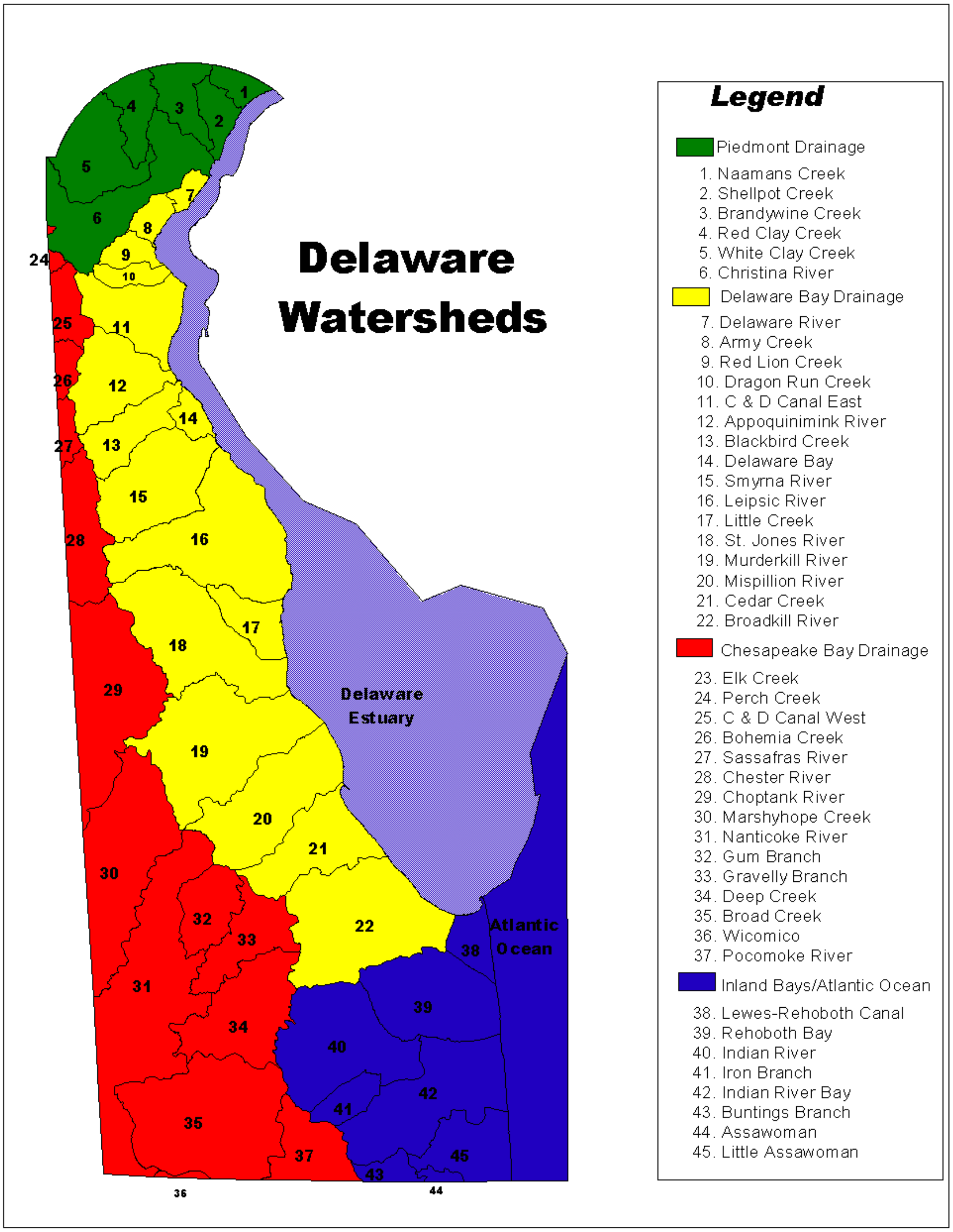
- Describe general surface water quality conditions in the State;
- Identify long term trends in surface water quality;
- Determine the suitability of Delaware surface waters for water supply, recreation, fish and aquatic life, and other uses;
- Monitor achievement of Surface Water Quality Standards;
- Identify and prioritize high quality and degraded surface waters;
- Calculate annual nutrient loads and track progress toward achieving Total Maximum Daily Loads (TMDLs) targets; and
- Evaluate the overall success of Delaware's water quality management efforts.

There are four major components to Delaware's Surface Water Quality Monitoring Program:

- General Assessment Monitoring
- Biological Assessment Monitoring
- Toxics in Biota Monitoring
- Toxics in Sediment Monitoring

This report discusses the General Assessment Monitoring and Biological Assessment Monitoring. Current Toxics in Biota and Sediment Monitoring plans are available on request.

Figure 1. State of Delaware Basins



Part I The General Assessment Monitoring Network (GAMN)

The General Assessment Monitoring Network (GAMN) provides for routine water quality monitoring of surface waters throughout Delaware. Each station is monitored for conventional parameters such as nutrients, bacteria, dissolved oxygen, pH, alkalinity, and hardness. Some stations are monitored for dissolved metals. See tables 2 and 3 for parameters and methods. See Appendix A for a sampling schedule and estimated costs for the surface water component. The data from this monitoring is entered into the STORET database, is reviewed and then analyzed in assessing the water quality of each basin for the Watershed Assessment Report (CWA Section 305 (b) Report). The Department anticipates co-operating with EPA in migrating from the STORET platform to the new WQX platform.

The plan provides for monitoring at stations within each watershed in the state. The network was recently reviewed and updated. The review is discussed in section I.1. See also Table 1: FY 2012 Monitoring Plan and Schedule.

I.1 Changes for Surface Water Quality Monitoring Plan

Over the past several years, a main objective of the Watershed Assessment Section's Ambient Surface Water Quality Monitoring Program was to collect water quality data that could be used for developing and calibrating hydrodynamic and water quality models. These models were used to establish Total Maximum Daily Loads (TMDLs) for nutrients and bacteria in impaired waters of the State.

Now, with the establishment of nutrient and bacteria TMDLs for most impaired waters of the State, a major objective of the Ambient Surface Water Quality Monitoring Program is to collect appropriate data that can be used to track water quality changes and to determine if TMDL requirements are being met.

Considering this (and other emerging) needs, and since the Department's monitoring budget is limited, surface water quality monitoring plan has been prepared with the following changes: Monitoring stations in earlier monitoring plans were reviewed to determine which stations were critical to meet data needs and which could be dropped. The retained stations fall into 2 categories;

Stations were assigned to one of the following categories:

  a. C1 – Category 1 stations are high priority stations that will be used for calculating annual loads and/or long-term trends. These stations are generally co-located with a USGS stream gaging station, or are located at the mouth of a tidal river. Because of importance of these stations, monitoring at these stations will be conducted monthly, regardless of priority basin schedule (23 stations)
  b. C2 – The remaining stations are part of Category 2 stations and monitoring frequency at these stations follow Priority Basin schedule.

2. A Rotating Basin Monitoring Plan is implemented. In this scheme of monitoring, the State is divided into 5 Monitoring Basins. Every year, two of the Basins are considered "Priority Basins" and all stations in a Priority Basin are monitored

monthly. Monitoring frequency for stations in other basins are conducted bimonthly. Priority Basin monthly monitoring will be conducted according to the following schedule:

a. FY 2009 – Lower Delaware River/Bay, Piedmont
b. FY 2010 – Piedmont, Chesapeake
c. FY 2011 – Chesapeake, Inland Bays
d. FY 2012 – Inland Bays, Upper Delaware River/Bay
e. FY 2013 – Upper Delaware, Lower Delaware River/Bay

I.2 Objectives

The objective of this monitoring is to collect water quality data for status and trends assessment on all basins within Delaware. The data will also be compared to water quality standards to assess designated use support, as mandated by Section 305(b) of the Clean Water Act. In addition, the data will be used to calculate annual nutrient loads and to track progress toward achieving TMDL targets.

I.3 Scope of Monitoring

Table 1 provides a listing of all stations to be monitored during FY 2012, and predicted sampling needs for upcoming fiscal years.

Table 2 provides a listing of parameters that will be monitored at all stations in the network. Stations shown for metals testing in Table 1 shall be sampled according to the specifications in Table 3.

Part II Special Project Monitoring

Special project monitoring is needed from time to time in specific watersheds to address specific concerns. These projects are generally short term in nature. The Department is not conducting any special projects during the FY 2012 monitoring year.

II.1 Special Surveys

The purpose of special survey monitoring is to collect data that are not obtained using other monitoring activities and are needed for modeling purposes as described above. Special surveys include deployment of continuous monitors (YSI Data Sondes) and sediment sampling. No special survey sediment sampling is called for in this monitoring year.

II.2 Continuous Monitoring

The Department is implementing a network of continuous water quality monitoring stations to collect data for dissolved oxygen and other parameters several times each day using YSI (or similar) datasondes. The Department is cooperating with Delaware Geological Survey (DGS) and the United States Geological Survey (USGS) in operating a number of continuous monitors in the State. The information from these continuous monitoring sites are available on real-time basis via the USGS website and via the Delaware Environmental Observing System (DEOS) website. The Department had also put into place a special highly sophisticated on-site monitoring station/automated lab device to collect and analyze samples for nutrients and other parameters at the outlet to Millsboro Pond. The data from this station were used to assess nutrient loads leaving the pond and entering the Delaware Inland Bays and thereby monitor TMDL implementation progress. It is planned to move this automatic data analyzer to the Nanticoke River Watershed during FY 2012 and deploy it at the Bridgeville stream flow gaging site.

Boat run surveys

Boat run surveys should be conducted within one day of tributary sampling in the watershed.

Part III Field and Laboratory Procedures

Field procedures for sample collection activities are detailed in the Quality Assurance Management Plan, Environmental Laboratory Section. Method references, STORET codes and reporting levels for parameters listed in Table 2 are from an Access database maintained by the Environmental Laboratory Section. Any deviation from standard field, laboratory procedures, or this sampling plan shall be documented with a complete description of the alteration.

Part IV Quality Assurance, Documentation, Data Usage and Reporting

The quality assurance objectives and quality control procedures for these surveys are documented in the Quality Assurance Management Plan, Environmental Laboratory Section. A duplicate water column sample will be collected and analyzed on 10% of the samples from this project. All analytical results from the duplicate analyses shall be reported with the other data.

All analytical results shall be reported to the Watershed Assessment Section digitally and on paper (using standard Environmental Laboratory Section data report forms).

Table 1 Station Locations, Descriptions Parameters and Sampling Frequency

STATION INFORMATION - FY 2012	*STORET #*	*Cu, Pb & Zn*	*As*	*Fe*	*DIN & DIP*	*Storm Events*	*No. of Samples in 2011*
PIEDMONT DRAINAGE							
Brandywine Creek							
Brandywine Creek @ Foot Bridge in Brandywine Park	104011	✓					6
Brandywine Creek @ New Bridge Rd. (Rd. 279)(USGS gage 01481500)	104021	✓				3 storms	12
Brandywine Creek @ Smith Bridge Rd. (Rd. 221)	104051	✓					6
Christina River							
Christina River beneath Rt. 141 in Newport off Water St.	106021	✓					6
Little Mill Creek @ DuPont Rd.	106281	✓					6
Christina River @ Conrail Bridge (USGS tide gage 01481602)	106291	✓					12
Christina River @ Nottingham Rd. (Rt. 273) above Newark	106191	✓					6
Christina River @ Sunset Lake Rd. (Rt. 72) (USGS 01478000 at Cooches bridge)	106141	✓				3 storms	12
Smalleys Dam Spillway @ Smalleys Dam Rd.	106031	✓					6
Red Clay Creek							
Red Clay Creek @ W. Newport Pike (Rt. 4) Stanton (USGS gage 01480015)	103011	✓					6
Burrough's Run @ Creek Rd. (Rt 82)	103061	✓					6
Red Clay Creek @ Barley Mill Rd. (Rd. 258A) Ashland	103041	✓					6
Red Clay Creek @ Lancaster Pike (Rt. 48) Wooddale (USGS gage 01480000)	103031	✓				3 storms	12
White Clay Creek							
White Clay Creek @ Delaware Park Blvd. (Race Track) (USGS gage 014790000)	105151	✓				3 storms	12
White Clay Creek @ McKees Lane	105171	✓					6
White Clay Creek @ Chambers Rock Rd. (Rd. 329)	105031	✓					6
Naamans Creek							
Naaman Creek @ State Line near Hickman Rd.	101021						6
Naaman Creek @ RR crossing in Steel Plant	101041						6
Naamans Creek at Rt 3 (Marsh Road)	101061						6
Shellpot Creek							
Shellpot Creek @ Hay Rd. (Rd. 501)	102041			✓			6
Rt. 13 Bus (Market Street) Bridge, USGS station is located about 700 ft downstream.	102051					3 storms	12
Shellpot Crk at Carr Road Bridge	102081						6
CHESAPEAKE BAY DRAINAGE							
Chester River							
Sewell Branch @ Sewell Branch Rd. (Rd. 95)	112021						6
Choptank River							
Cow Marsh Creek @ Mahan Corner Rd. (Rd. 208)	207021						6
Tappahanna Ditch @ Sandy Bend Rd. (Rd. 222)	207081						6
Culbreth Marsh Ditch @ Shady Bridge Rd. (Rd. 210)	207091						6
White Marsh Branch @ Cedar Grove Church Rd. (Rd. 268)	207111						6

STATION INFORMATION - FY 2012	STORET #	Cu, Pb & Zn	As	Fe	DIN & DIP	Storm Events	No. of Samples in 2011
Marshyhope Creek							
Marshyhope Creek @ Fishers Bridge Rd. (Rd. 308)	302031					8 storms	12
Nanticoke River							
Nanticoke River @ buoy 45 (near state line)	304071	✓					6
Nanticoke River @ buoy 66 (confluence with DuPont Gut)	304151	✓					6
Nanticoke River Tributaries							
Racoon Prong @ Pepperbox Rd. (Rd. 66)	304671	✓					6
Nanticoke River @ Rifle Range Rd. (Rd. 545)	304191	✓				8 storms	12
Concord Pond @ German Rd. (Rd. 516)	304311	✓					6
Williams Pond @ East Poplar St. (across from Hospital)	304321	✓					6
Bucks Branch @ Conrail Rd. (Rd. 546)	304381	✓					6
Nanticoke River @ Rt. 13	304471	✓					6
Records Pond @ Willow St.	307011	✓					6
Horseys Pond @ Sharptown Rd. (Rt. 24)	307171	✓					6
Gravelly Branch @ Coverdale Rd. (Rd. 525)	316011	✓					6
Trap Pond on Hitch Pond Branch @ Co. Rd. 449 or Trap Pond Rd	307081	✓					6
Deep Creek above Concord Pond, near Old Furnace at Rd. 46	304591	✓					6
Gravelly Branch at Deer Forest Road (Rd 565) on west edge of Redden State Forest Jester Tract	316031	✓					6
Broad Creek at Main Street in Bethel (Rd 493)	307031	✓					6
Nanticoke River at Beach HWY (Ellendale Greenwood HWY) on east edge of Greenwood	304681	✓					6
Pocomoke River							
Pocomoke River @ Bethel Rd. (Rd. 419)	313011						6
DELAWARE BAY DRAINAGE							
Appoquinimink River							
Drawyer Creek off DuPont Parkway. (Rt. 13) at parking area	109071	✓					12
Shallcross Lake @ Shallcross Lake Rd. (Rd. 428)	109191	✓					12
Noxontown Pond @ Noxontown Rd. (Rd. 38)	109131	✓					12
Appoquinimink River @ DuPont Prkwy. (Rt. 13)	109041	✓					12
Appoquinimink River @ MOT Gut (west bank)	109171	✓					12
Deep Creek Br of Appoquinimik River at Rt. 71 Bridge (Middletown Natural Area), duplicate with 109081	109251	✓				3 storms	12
Appoquinimink River @ Silver Run Rd. (Rt. 9) NE side	109121	✓					12
Appoquinimink River @ confluence with Delaware River	109091	✓					12
Army Creek							
Army Creek @ River Rd. (Rt. 9)	114011						12
Chesapeake & Delaware Canal							
C & D Canal @ DuPont Pky. (Rt. 13) St. Georges Bridge	108021						12
Lums Pond @ Boat ramp	108111						12
Dragon Run							

STATION INFORMATION - FY 2012	***STORET #***	***Cu, Pb & Zn***	***As***	***Fe***	***DIN & DIP***	***Storm Events***	***No. of Samples in 2011***
Dragon Creek @ Wrangle Hill Rd. (Rt. 9)	111011						12
Dragon Creek @ S. DuPont Hgwy. (Rt. 13)	111031						12
Red Lion Creek							
Red Lion Creek @ Bear Corbitt Rd. (Rt. 7)	107011						12
Red Lion Creek @ Rt. 9	107031						12
Blackbird Creek							
Blackbird Creek, Road 463 East of RR Tracks. USGS gage	110011					3 storms	12
Blackbird Landing Rd 455	110031						12
Blackbird Creek @ Taylors Bridge Rd. (Rt. 9)	110041						12
Leipsic River							
Garrisons Lake @ DuPont Highway (Rt. 13)	202021						12
Leipsic River @ Denny St. (Rt. 9)	202031						12
Upstream of Masseys Millpond at Rt. 15	202191						12
Little River							
Little River @ Bayside Dr. (Rt.9)	204031						12
Little River @ N. Little Creek Rd. (Rt. 8)	204041						12
Smyrna River							
Mill Creek @ Carter Rd. (Rd. 137)	201021						12
Smyrna River @ Rt. 9 (Flemings Landing)	201041						12
Duck Creek @ Smyrna Landing Rd. (Rd. 485)	201051						12
201011 Mill Creek at Rt. 13	201011						12
Providence Creek @ Duck Creek Rd. (Rt.15)	201161						12
Broadkill River							
Ingram Branch, Savanah Ditch @ Rd. 246	303011						6
Ingram Branch @ Rd. 248	303021						6
Rt. 5 Bridge	303031					3 storms	12
Rt. 1 Bridge (Mainstem)	303041						6
Broadkill River 0.10 Miles From Mouth of Broadkill	303061						12
Red Mill Pond at Rt. 1	303051						6
Beaverdam Creek at Rd. 88	303171						6
Beaverdam Creek above Rd. 259, Hunters Mill Pond	303181						6
Round Pole Branch at Rd. 88	303311						6
Waples Pond at Rt. 1	303331						6
Pemberton Branch at Rt. 30 above Wagamons Pond	303341						6
Cedar Creek							
Swiggetts Pond @ Cedar Creek Rd. (Rt. 30)	301021						6
Cedar Creek @ Coastal Hgwy. (Rt. 1)	301031						6
Cedar Creek @ Cedar Beach Rd. (Rt. 36)	301091						6
Mispillion River							
Mispillion River @ Rt. 1	208021						6
Mispillion River/Cedar Creek confluence @ Lighthouse	208061						12
Mispillion River @ mouth of Fishing Branch	208121						6
Abbotts Pond @ Abbotts Pond Rd. (Rd. 620)	208181						6
Silver Lake @ Maple Ave.	208211						6
Beaverdam Branch @ Deep Grass Ln. (Rd. 384)	208231						6
Delaware Bay							
Roosevelt Inlet, Mouth	401011						6

STATION INFORMATION - FY 2012	STORET #	Cu, Pb & Zn	As	Fe	DIN & DIP	Storm Events	No. of Samples in 2011
Murderkill River							
Murderkill River @ confluence of Black Swamp Creek at Rt. 13	206011	✓				3 storms	12
Browns Branch @ Milford - Harrington Hwy. (Rt. 14)	206041	✓					6
Murderkill River @ Bay Rd. (Rt. 1/113)	206091	✓					6
Murderkill River @ Bowers Beach Wharf (mouth)	206101	✓					12
Murderkill River near levee @ Milford Neck Wildlife Area (3.25 miles from mouth)	206141	✓					6
Murderkill River @ confluence of Kent County WWTF discharge ditch	206231	✓					6
McColley Pond @ Canterbury Rd. (Rt. 15)	206361	✓					6
Coursey Pond @ Canterbury Rd. (Rt. 15)	206451	✓					6
Double Run @ Barretts Chapel Rd. (rd. 371)	206561	✓					6
St. Jones River							
St. Jones River @ Barkers Landing	205041						12
St. Jones River @ Rt. 10	205091						12
Fork Branch @ State College Rd. (Rd. 69)	205151						12
Moores Lake @ S. State St.	205181						12
Silver Lake @ Spillway (Dover City Park)	205191					3 storms	12
St. Jones at Bowers Beach, mouth to Del.Bay.	205011						12
Derby Pond @ Rt. 13A	205211						12
INLAND BAYS DRAINAGE							
Tributary Stations							
Burton Pond @ Rt. 24	308031	✓	✓		✓		12
Millsboro Pond @ Rt. 24	308071	✓	✓		✓	3 storms	12
Pepper Creek @ Rt. 26 (Main St.)	308091	✓	✓		✓		12
Blackwater Creek @ Omar Rd. (Rd. 54)	308361	✓	✓		✓		12
Dirickson Creek @ Old Mill Bridge Rd. (Rd. 381)	310031	✓	✓		✓		12
Bunting Branch							
Buntings Branch @ Rt. 54 (Polly Branch Rd.)	311041	✓	✓		✓		12
Guinea Creek							
Guinea Creek @ Banks Rd. (Rd. 298)	308051	✓	✓		✓		12
Iron Branch							
Whartons Branch @ Rt. 20 (Dagsboro Rd.)	309041	✓	✓		✓		12
Lewes & Rehoboth Canal							
Lewes & Rehoboth Canal @ Rt. 9	305041	✓	✓		✓		12
Little Assawoman Canal							
Little Assawoman Bay @ Rt. 54 (The Ditch)	310011	✓	✓		✓		12
White Creek @ mouth of Assawoman Canal	312011	✓	✓		✓		12
Love Creek							
Bundicks Branch @ Rt. 23	308371	✓	✓		✓		12
Miller Creek							
Beaver Dam Ditch @ Beaver Dam Rd. (Rd. 368)	310121	✓	✓		✓		12
Stockley Branch/Cow Bridge							
Cow Bridge Branch @ Zoar Rd. (Rd. 48)	308281	✓	✓		✓		12
Swan Creek							
Swan Creek @ Mount Joy Rd. (Rd. 297)	308341	✓	✓		✓		12
Vines Creek							
Ocean Boundary Stations							

STATION INFORMATION - FY 2012	***STORET #***	***Cu, Pb & Zn***	***As***	***Fe***	***DIN & DIP***	***Storm Events***	***No. of Samples in 2011***
Lewes & Rehoboth Canal @ Rt. 1	305011	✓	✓		✓		12
Indian River Inlet @ Coast Guard Station	306321	✓	✓		✓		12
Boat Run Stations							
Rehoboth Bay @ Buoy 7	306091	✓	✓		✓		12
Masseys Ditch @ Buoy 17	306111	✓	✓		✓		12
Indian River Bay @ Buoy 20	306121	✓	✓		✓		12
Indian River @ Buoy 49 (Swan Creek)	306181	✓	✓		✓		12
Indian River @ Island Creek	306331	✓	✓		✓		12
Island Creek upper third	306341	✓	✓		✓		12
Little Assawoman Bay Mid-bay (Ocean Park Lane)	310071	✓	✓		✓		12

Table 2 Water Quality Parameters to be analyzed at all Stations in the Monitoring Network, FY 2012

Parameter	*Method Reference (EPA)*	*Reporting Level*[1]
Water Column Nutrients		
Total Phosphorus	EPA365.1 M	0.005 mg/l P
Soluble Ortho-phosphorus	EPA365.1	0.005 mg/l P
Ammonia Nitrogen	EPA350.1	0.005 mg/l N
Nitrite+Nitrate N	EPA353.2	0.005 mg/l N
Total N	SM 4500 NC	0.08 mg/l N
Carbon and Organics		
Total Organic Carbon	EPA415.1	1 mg/l
Dissolved Organic Carbon	EPA415.1	1 mg/l
Chlorophyll-a (Corr)	EPA 445.0	1 μg/l
Biochemical Oxygen Demand		
BOD_5, N-Inhib (CBOD)	SM20thed-5210B	2.4 mg/l
BOD_{20}, N-Inhib (CBOD)	SM20thed-5210B	2.4 mg/l
General		
Dissolved oxygen – Winkler[2]	EPA360.2	0.25 mg/l
Dissolved oxygen – Field	EPA360.1	0.1 mg/l
Total Suspended Solids	EPA160.2	2 mg/l
Alkalinity	EPA310.1	1 mg/l
Hardness	EPA130.2	5 mg/l
Field pH	EPA150.1	0.2 pH units
Conductivity – Field	EPA120.1	1 μS/cm
Salinity	SM20thed-2520B	1 ppt
Temperature	EPA170.1	^{o}C
Secchi Depth[3]	EPA/620/R-01/003	meters
Light Attenuation[4]	EPA/620/R-01/003	%
Turbidity	EPA180.1	1 NTU
Chloride	EPA325.2	1 mg/l
Bacteria		
Enterococcus	SM20thed-9230C	1 cfu/100 ml

[1] As documented in the ELS Quality Assurance Management Plan, the ELS defines the Limit of Quantitation (LOQ) as the lowest standard in the calibration curve or, in instances where a standard curve is not specified by the procedure, LOQ represents the limitations of the method. For those tests where reference spiking material exists, the ELS measures Method Detection Limit (MDL), as defined in the Federal Register 40 CFR Part 136 Appendix B. MDL values are generated or verified once per year. Results less than the MDL are considered to be not detected and “< MDL” is reported. Results greater than the MDL but less than the LOQ are qualified with a J to indicate a result that is extrapolated or estimated. For tests where MDL is not applicable, results less than the LOQ are reported as “< LOQ”, ELS MDLs meet or exceed (i.e. are lower than) the reporting level requirements listed in Table 3.

[2] Secchi Depth to be measured at designated stations.

[3] Light attenuation to be conducted as practical to obtain correlation with Secchi disk readings

Table 3 Metals Parameters

Dissolved Metals (dissolved and total)	***Method Reference (EPA)***	***Reporting Level***
Copper	EPA 200.7 M	5.0 ug/l
Lead	EPA 200.7 M	3.0 ug/l
Zinc	EPA 200.7 M	10 ug/l
Iron	EPA 200.7 M	100 ug/l

Appendix A: FY 2012 Surface Water Monitoring Schedule & Cost Estimate

Project	Basin/ Sub-basin/ Watershed	Number of Samples												Cost					
		Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	# Samples	Analytical Chemistry	Metals	WQX	Field Costs	Total
	Brandywine Creek	3		3		3		3		3		3							
	Christina River	6		6		6		6		6		6							
Northern Piedmont	Red Clay Creek	4		4		4		4		4		4		120	$36,480	$7,200	$300	$9,000	$52,980
	White Clay Creek	3		3		3		3		3		3							
	Duplicates + Field Blanks	4		4		4		4		4		4							
UD Farm	University of Delaware Farm	6	6		6	6		6	6		6	6		56	$8,176	$0	$0	$0	$8,176
	Duplicates + Field Blanks	1	1		1	1		1	1		1	1							
	Naaman's Creek	3		3		3		3		3		3							
Northeast Piedmont	Shellpot Creek	3		3		3		3		3		3		48	$14,592	$540	$300	$4,500	$19,932
	Duplicates + Field Blanks	2		2		2		2		2		2							

Project	Basin/ Sub-basin/ Watershed	Number of Samples												Cost					
		Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	# Samples	Analytical Chemistry	Metals	WQX	Field Costs	Total
Piedmont Monthly	Piedmont Monthly		6		6		6		6		6		6	48	$14,592	$2,520	$300	$4,500	$21,912
	Duplicates + Field Blanks		2		2		2		2		2		2						
North Delaware Bay Drainage	Army Creek	1	1	1	1	1	1	1	1	1	1	1	1	108	$32,832	$0	$600	$9,000	$42,432
	C & D Canal	2	2	2	2	2	2	2	2	2	2	2	2						
	Dragon Creek	2	2	2	2	2	2	2	2	2	2	2	2						
	Red Lion Creek	2	2	2	2	2	2	2	2	2	2	2	2						
	Duplicates + Field Blanks	2	2	2	2	2	2	2	2	2	2	2	2						
Appoquinimink River	Appoquinimink	8	8	8	8	8	8	7	7	8	8	8	8	118	$35,872	$7,080	$600	$12,375	$55,927
	Duplicates + Field Blanks	2	2	2	2	2	2	2	2	2	2	2	2						
Delaware Bay Drainage	Blackbird Creek	3	3	3	3	3	3	3	3	3	3	3	3	180	$54,720	$0	$600	$9,000	$64,320

Project	Basin/ Sub-basin/ Watershed	Number of Samples												Cost					
		Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	# Samples	Analytical Chemistry	Metals	WQX	Field Costs	Total
	Leipsic River	3	3	3	3	3	3	3	3	3	3	3	3						
	Little River	2	2	2	2	2	2	2	2	2	2	2	2						
	Smyrna River	5	5	5	5	5	5	5	5	5	5	5	5						
	Duplicates + Field Blanks	2	2	2	2	2	2	2	2	2	2	2	2						
St. Jones River	St. Jones River	7	7	7	7	7	7	7	7	7	7	7	7	108	$32,832	$0	$600	$9,000	$42,432
	Duplicates + Field Blanks	2	2	2	2	2	2	2	2	2	2	2	2						
Murderkill River	Murderkill								7		9		9	33	$10,032	$1,980	$150	$4,425	$16,587
	Duplicates + Field Blanks								2		3		3						
Murderkill River Profiles	Murderkill		17		17		17							63	$19,152	$3,780	$150	$5,513	$28,595
	Duplicates + Field Blanks		4		4		4												

Project	Basin/ Sub-basin/ Watershed	Number of Samples												Cost					
		Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	# Samples	Analytical Chemistry	Metals	WQX	Field Costs	Total
Delaware Bay Monthly	Broadkill River Monthly	2		2		2		2		2		2		42	$12,768	$1,440	$300	$4,500	$19,008
	Mispillion River Monthly	1		1		1		1		1		1							
	Murderkill Monthly	2		2		2		2		2		2							
	Duplicates + Field Blanks	2		2		2		2		2		2							
South Delaware Bay Drainage	Cedar Creek		3		3		3		3		3		3	66	$20,064	$0	$300	$4,500	$24,864
	Mispillion River		6		6		6		6		6		6						
	Duplicates + Field Blanks		2		2		2		2		2		2						
Broadkill River	Broadkill River		11		11		11		11		11		11	78	$23,712	$0	$300	$4,500	$28,512
	Duplicates + Field Blanks		2		2		2		2		2		2						
Inland Bays	Inland Bays	24	24	24	24	24	24	19	19	24	24	24	24	362	$136,648	$26,250	$600	$34,875	$198,373

Project	Basin/ Sub-basin/ Watershed	Number of Samples												Cost					
		Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	# Samples	Analytical Chemistry	Metals	WQX	Field Costs	Total
	Delaware Bay	1		1		1		1		1		1							
	Pocomoke River	1		1		1		1		1		1							
	Duplicates + Field Blanks	6	6	6	6	6	6	6	6	6	6	6	6						
Nanticoke River	Nanticoke River		15		15		15		13		15		15	112	$34,048	$6,720	$300	$10,688	$51,756
	Duplicates + Field Blanks		4		4		4		4		4		4						
Chesapeake Bay Nontidal	Chesapeake Bay Nontidal	2	2	2	2	2	2	2	2	2	2	2	2	48	$14,592	$0	$600	$9,000	$24,192
	Duplicates + Field Blanks	2	2	2	2	2	2	2	2	2	2	2	2						
Chesapeake Bay Drainage	Chester River		1		1		1		1		1		1	30	$9,120	$0	$300	$4,500	$13,920
	Choptank River		4		4		4		4		4		4						
Chesapeake Bay Nontidal Storm	Storm Sites	2		2	2		2	2		2	2		2	32	$12,256	$0	$400	$6,000	$18,656

Project	Basin/ Sub-basin/ Watershed	Number of Samples												Cost					
		Jul-11	Aug-11	Sep-11	Oct-11	Nov-11	Dec-11	Jan-12	Feb-12	Mar-12	Apr-12	May-12	Jun-12	# Samples	Analytical Chemistry	Metals	WQX	Field Costs	Total
	Duplicates + Field Blanks	2		2	2		2	2		2	2		2						
Statewide Storm	Storm Sites	11			11						11			45	$14,364	$1,980	$150	$4,500	$20,994
	Duplicates + Field Blanks	4			4						4								
TOTALS														1697	$536,852	$59,490	$6,850	$150,375	$753,567
Shellfish & Recreational Waters																			$21,000
Grand Total																			***$774,567***

Appendix C: Upper Chesapeake Watershed Tributary Action Team Pollution Control Strategy Recommendations – 2008

UPPER CHESAPEAKE WATERSHED TRIBUTARY ACTION TEAM POLLUTION CONTROL STRATEGY RECOMMENDATIONS

January 31, 2008

The purpose of the Upper Chesapeake Watershed Pollution Control Strategy recommendations is to achieve the reductions in nutrient and bacteria levels required in the Total Maximum Daily Load (TMDL) for the watershed in order to reduce the pollutants reaching the Chester and Choptank Rivers.

The specific goals of the Tributary Action Team were to reduce the pollutants to levels at or below the TMDL values specified in the regulation establishing the TMDLs for the Chesapeake Drainage Watersheds in Delaware[1], specifically, maintenance of the level of Nitrogen at or below the 2001-2003 level, a reduction in Phosphorus of 40% and a reduction in Bacteria of 75.6% and 87.8% (for the Chester and Choptank watersheds respectively). In addition, the Team considered additional reductions to contribute to meeting the Chesapeake Bay Agreement reductions of 47% for Nitrogen and 44% for Phosphorus.

Tributary Action Team Guidelines

The following guidelines were used by the Tributary Action Team in developing the recommendations for the Pollution Control Strategy:

- Community education is a high priority.
  - We will not change mindsets and behaviors unless we have an educated populace.
- Apply the “Fairness Principle”
  - Any regulations should apply to everyone, but add provisions to deal with costs for hardship cases.
- Recommendations should be “do-able”, with anticipated results in a reasonable period of time.
- Recommendations should be based on what makes sense given the topography, hydrology, available infrastructure services, utilities, and designated land use criteria.
- Recommendations should deal with the root source of the problem, not just the symptoms.
- Recommendations should be based on proven “good” science, not “politically correct” science.
- Take the regulations and land use changes in the Kent County Land Use Plan into consideration as recommendations are developed.
- Think “Long Term” in developing recommendations

[1] Secretary’s Order No. 2005-W-0050 Re: Adopting Final Regulations to Establish Total Maximum Daily Loads for the Chesapeake Drainage Watersheds in Delaware of the Chester River, the Choptank River, Marshyhope Creek and the Pocomoke River, Date of Issuance: December 15, 2005, Effective Date: January 11, 2006

Reduction Goals and Requirements

The Total Maximum Daily Loads (TMDLs) for the Chester and Choptank River Watersheds were adopted December 2005. The TMDLs were promulgated for Nitrogen, Phosphorus and Bacteria. The TMDL required reductions are shown in the table below. These are the reduction goals for the Pollution Control Strategy recommendations.

	Total Nitrogen	**Total Phosphorus**	**Bacteria**
Required Reduction from Baseline	Chester – Capped Choptank - Capped	Chester – 40% Choptank – 40%	Chester – 75.6% Choptank – 87.8%
Required Reduction in Average Pollutant Load	Chester – 0 lbs/day Choptank – 0 lbs/day	Chester – 12.3 lbs/day Choptank – 51.1 lbs/day	Chester – 1.44E+11 CFU/day Choptank–3.86E+11 CFU/day

CFU – Colony Forming Unit

In addition to the TMDLs, these watersheds are in the Chesapeake Bay Watershed. Delaware has signed onto the Chesapeake Bay Agreement which calls for nutrient reductions of 47% for Nitrogen and 44% for Phosphorus. These reductions are total for all watersheds in Delaware that drain into the Chesapeake Bay, and are not specific to any watershed. Therefore, these reduction numbers were considered to be goals by the Tributary Action Team, not requirements.

Overview of the Watersheds

The Chester and Choptank River Watersheds in Delaware share most of their characteristics, and thus were treated as one watershed by the Tributary Action Team for the purpose of developing the Pollution Control Strategy recommendations.

The watersheds are located along the western boundary of Delaware, between the Sassafras River Watershed in the north and the Marshyhope Creek Watershed in the south. The bulk of the watersheds are in Kent County, but include sections in both New Castle and Sussex Counties. The main towns in the watersheds are Marydel and Hartly. The watersheds cross the border into Maryland, however the pollution control strategy recommendations only address the portion of the watersheds within Delaware.

The watersheds are predominantly agricultural, with wetlands and forests as the next largest land covers. New houses and housing developments, however, are being planned and built in the watershed.

Since there are no active point source discharges in the watershed, all nutrient sources are non-point sources and therefore, all recommended actions address reductions in non-point sources of pollution.

Land use loading rates for the Chester and Choptank watershed based upon TMDL data		
	TN (lbs/acre/yr)	**TP (lbs/acre/yr)**
Developed	12.0	1.3
Agriculture	15.5	0.4
Grasslands	0.8	0.26
Forests	3.5	0.1
Wetlands	0.0	0.0

Using the land use loading rates listed in the above table, the nutrient loads coming from nonpoint sources during the baseline period could be determined using the equation below.

Load for land-use type by reduction area (lbs/ day)	=	Acreage of specific land-use	x	Loading rate for that land-use type (lbs/acre/yr) divided by 365 days

The daily nutrient load reductions needed from nonpoint sources in order to achieve the reductions outlined in the Chester and Choptank watersheds TMDL are calculated using the following equation.

Required TMDL Reduction (lb/day)	=	Total baseline period load for area (lb/day)	x	Percent reduction as required in TMDL

Current Best Management Practices in the Watersheds

The Chester and Choptank watersheds have a considerable number of BMPs in practice which bring the watersheds close to compliance with the TMDLs. This section will present details on the BMPs in practice and their associated nutrient reductions. The following table summarizes the reductions from the BMPs and where that places the watersheds with regard to compliance with the TMDLs and the reductions for the Chesapeake Bay Program.

	Nitrogen Load Reduction (lb/day)	**Percent of Required Reduction Achieved**	**Phosphorus Load Reduction (lb/day)**	**Percent of Required Reduction Achieved**
Total for Existing BMPs	764.76		23.65	
Reduction Needed for TMDL	0	>100%	31.56	74.9%
Reduction need for Chesapeake Bay	956.81	79.9%	37.08	63.8%

Specific information regarding bacteria is not included in the above chart, nor in most of the recommendations, since the analysis of source tracking data is not yet available.

Wastewater BMPs

Individual septic systems with 3-year pump-outs: There are 6,239 septic systems in the watersheds. Load reductions from 3-year pump-outs are: 2.97 lbs/day TN, 1.19 Lbs/day TP.

The septic systems in Hartly will be eliminated through connection to the Kent County Wastewater Treatment Plant. This will result in a loadings reduction of 3.11 lbs/day TN, 1.23 lbs/day TP.

Stormwater BMPs[2]

Stormwater BMPs in use in the watersheds are Dry Extended Detention Ponds, Wet Ponds, and Infiltration Practices. The acreage treated and resultant nutrient reductions are shown below.

	Acreage Treated	TN Load Reduction	TP Load Reduction
Dry Extended Detention Ponds	192.65	.95 lbs/day	.17 lbs/day
Wet Ponds	2.00	.02 lbs/day	.00 lbs/day
Infiltration Practices	1.00	.02 lbs/day	.00 lbs/day
TOTAL		**.99 lbs/day**	**.18 lbs/day**

Agricultural BMPs

Agricultural BMPs are the most significant source of current nutrient reductions in the watersheds, accounting for over 99% of the nitrogen reductions and almost 94% of the phosphorus reductions. The following table summarizes the number of acres utilizing each BMP and the load reductions for that BMP[3].

	Acres	Nitrogen Load Reduction (lbs/day)	Phosphorus Load Reduction (lbs/day)
Cover Crops	7,310.34	182.88	0.39
Water Control Structures	0	0	0
CRP Practices			
Ponds	83.80	3.55	0.09
Grassed Waterways	0	0	0
Grassed Filter Strips	55.50	1.21	0.02
Wildlife Habitat	107.90	2.36	0.04
CREP Practices			
Grass Buffers	114.90	6.99	0.18
Grassed Filer Strips	0	0	0
Forest Buffers	102.20	8.73	0.22
Riparian Buffers	0	0	0
Wetlands	67.40	6.40	0.17
Wildlife Plants	88.70	5.41	0.14
Hardwood Plants	0	0	0
Conservation Tillage	41,995.00		0.08
Manure Relocation/Alt. Use	718	8.12	0.06
Phytase	2,321.74		0.07
Nutrient Management Plans	41,995.00	535.00	20.71
TOTAL		**760.65**	**22.17**

[2] From the Kent Conservation District, May 2006
[3] Data from Delaware Department of Agriculture, Nutrient Management Program, July 2006

Pollution Control Strategy Recommendations

The recommendations to reduce nutrients flowing into the Chester and Choptank Rivers can be grouped into five main categories:

- o Recommendations reducing nutrients from existing development in the watersheds;
- o Recommendations to minimize any increase in nutrients as land use changes from agriculture or forest to development;
- o Recommendations specifically addressing tax ditches;
- o Recommendations to provide incentives for additional nutrient reductions from agriculture;
- o Education-based recommendations.

RECOMMENDATIONS RELATING TO EXISTING DEVELOPMENT

1. Identify areas where stormwater retrofits would effectively reduce sediment and nutrients

DNREC should conduct a stormwater inventory and identify areas where treatment is lacking and determine where benefits could be obtained through design and construction of effective stormwater BMPs.

Expected Reduction: Nutrient reductions are a function of the type of stormwater BMP installed. Runoff volumes could be reduced by over 90% with infiltration practices. Up to 70% reductions in TN and 65% in TP can be achieved if stormwater BMPs are constructed and managed properly.

2. DNREC and the New Castle and Kent County Conservation Districts should educate Home Owners' Associations (HOAs) regarding the Stormwater BMP maintenance and management requirements and enforce these requirements.

The education process should include providing workshops and written material (such as the detailed booklet developed by DNREC's Sediment and Stormwater Program) about the requirements on the HOAs and proper maintenance practices for stormwater structures. In addition, the educational process should address the aesthetic value of stormwater ponds and the negative impact of improper disposal of yard wastes, animal wastes, and trash that end up in the stormwater structures.

Expected Reduction: This action will help ensure that the reductions associated with specific stormwater management techniques are achieved through proper maintenance.

3. Onsite Wastewater Treatment and Disposal Systems:
a. Promote biennial pump outs of individual onsite wastewater treatment and disposal systems.
b. Require pump out contractors to report failed onsite wastewater treatment and disposal systems to the Department of Natural Resources and Environmental Control.

It is estimated that 20% of the septic systems in the watershed fail annually. Currently, septic system permits require that the systems be pumped out every three years or when the system contains 30 percent or more of solids. The State or New Castle/Kent County should create a “maintenance incentive” for systems to be pumped out every two years. This could take the form of a tax credit for mailing in pump out receipts.

Expected Reduction: Loadings to groundwater from nutrients contained within the sewage and effluent are reduced over 3 year required pump-outs – Nitrogen by 200%, Phosphorus by 112%.

The following two recommendations must be enacted state-wide in order to be feasibly implemented. The Upper Chesapeake Tributary Action Team supports state-wide implementation of recommendations 4 and 5:

4. Require stores to require a soil test for fertilizer purchases or ban phosphorus in residential fertilizer sold in Delaware.

Over-application of nutrients by home owners occurs for two main reasons: lack of knowledge and the desire to use all the fertilizer that they purchased. Education will be necessary for homeowners regarding how to conduct a soil test. The education effort should include information on the environmental impact of fertilization and how lawn and plants take up and utilize the nutrients. Requiring a soil test will result in the sale of the correct amount of fertilizer for the specific lawn, reducing reason number two – over-purchase. As part of the soil test requirement, stores should be required to collect and report data on sales of residential fertilizer by zip code.

Expected Reduction: Although there will be nutrient reductions from this action, there is currently no information regarding the load reductions from this activity.

5. Enact legislation to ban the sale of detergents and soaps containing phosphates.

During the 1970s, the U.S. government recognized that laundry and dishwashing detergents were contributing to phosphorus pollution, which can cause massive algal blooms in waterways and destroy ecosystems by robbing the water and aquatic life of oxygen. Companies started to create alternative laundry detergents that did not contain phosphorus. By the 1990s, enough states had limited or restricted laundry detergent phosphates that detergent companies finally realized that, in order to appeal to their consumers, they would have to develop a phosphate-free detergent. Companies decided to voluntarily phase out all domestic formulations of detergents with phosphorus by the mid-1990s.

Dishwasher detergents on the other hand still contain harmful phosphates. The main reason for this is that the best alternative, enzymes, were neither common nor cheap even as late as the early '90s. There was also the influence of heavy lobbying by detergent makers to keep them in, so phosphates remain in many detergents at varying levels, even though they don't need to be there.

Expected Reduction: Although there will be nutrient reductions from this action, there is currently no information regarding the load reductions from this activity.

RECOMMENDATIONS RELATING TO CHANGES IN LAND USE

6. Require stormwater BMPs be designed to be "Green Technology BMPs" to reduce nutrients according to TMDLs; stormwater structures would be designed to reduce sediment, nutrients, and bacteria and would allow more infiltration, rather than water retention and detention.

Since 1991, stormwater runoff from new development has been regulated under the Delaware Sediment and Stormwater Regulations, administered by the DNREC Division of Soil & Water Conservation. As stormwater moves over land, it picks up natural and man-made pollutants from lawns, roads, and parking lots, eventually depositing them into the waters of the Chester and Choptank watersheds. Stormwater management is the primary way to control nonpoint source pollution from developed areas. A variety of methods can be used to control and treat runoff. "Green Technology BMPs" are those practices that achieve stormwater management objectives by applying the principles of filtration, infiltration and storage most often associated with natural vegetation and undisturbed soils while minimizing a reliance on structural components. These BMPs have been shown to be effective in nutrient reduction. Currently, the regulations prefer green technology BMPs, but do not require them.

Expected Reduction: Runoff volumes could be reduced by over 90% with infiltration practices. Up to 70% reductions in TN and 65% in TP can be achieved if stormwater BMPs are constructed and managed properly.

7. Require Low Impact Development (LID) in new construction and development.

LID is the integration of site ecological and environmental goals and requirements into all phases of urban planning and design, from the individual residential lot level to the entire watershed. LID varies from traditional stormwater practices; it reduces runoff volumes by attempting to recreate drainage patterns of the preconstruction state. LID practices include, but are not limited to: green roofs, permeable pavers, bioretention areas, grass swales, rain gardens and minimizing impervious area. These practices increase runoff infiltration, storage, filtering, evaporation and detention onsite. In addition, new homes should be required to be built without garbage disposals.

Expected Reduction: Not much research has been conducted on nutrient reductions associated with LID.

8. a. For septic systems for new construction, if the system fails due to design, the organization requiring the specific design for the system should be responsible for system replacement.
b. Provide "pilot/demonstration project" funding for new and proven on site waste-water systems, including RBD units, to replace failing septic systems.

Advanced engineered septic systems are required to be designed to meet specifications developed by the regulatory agency. When systems are installed properly to the regulatory specifications and the system does not function properly, currently, the homeowner is responsible for paying to have the system replaced or fixed.

Specific site conditions and homeowner financial constraints may preclude traditional septic system replacements. Pilot project funding opportunities should be explored in order to provide viable information relative to their expanded use within the Upper Chesapeake Watershed.

Expected Reduction: This action will ensure that regulatory agencies have appropriate incentives for designing advanced systems that function properly, thereby not causing additional loading of nutrients.

9. When land changes from agriculture to developed land, to reduce or eliminate nonpoint source pollution for lots abutting waters in the watersheds, require vegetated buffers of 20 feet beyond the end of the tax ditch maintenance right-of-way.

Buffers help to filter nutrients and slow overland stormwater flow. Kent County has issued several ordinances related to development and buffers, however, County setbacks are not required to be vegetated. Vegetation of the buffer will slow water flow and increase nutrient uptake.

Expected Reduction: Nutrient reduction is a function of buffer type (grassed, forested or combination) and the width of the buffer; nitrogen reductions can range from 2.5 to 70%. Reductions in Phosphorus reduction can range from 3.6 to 66%

RECOMMENDATIONS AFFECTING BOTH EXISTING DEVELOPMENT AND LAND USE CHANGES

10. Require a Nutrient Management Plan for any open space within a development

Open space within developments is often simply mowed and fertilized fields. Open space can have many valuable functions and should include natural areas. Open space should be developed with appropriate native vegetation and protected through easements. Nutrient management plans have been successful in improving the efficiency and effectiveness of nutrient applications for farm operations. Nutrient management plans should have similar impacts on the effectiveness of fertilizer use on open space within developments.

Expected Reduction: 10-15% reduction in nitrogen and phosphorous.

11. Prioritize areas where failing individual, large, and community wastewater treatment and disposal systems can be eliminated by connecting to the Kent County Waste Water Treatment Plant.

In the Chester and Choptank watersheds, surface and ground water are directly connected. Consequently, impacts on groundwater will impact the quality of the surface water. Nutrients and bacteria from onsite wastewater treatment and disposal systems will reach the surface water through the groundwater. There are 6239 septic systems in the two watersheds. An individual functioning onsite wastewater treatment and disposal system may contribute 5.8 lbs per year of phosphorous and 22 pounds per year of nitrogen. A failing system can contribute a significant increase in nutrients and bacteria. The prioritization should be used as one of the determining factors for locating sewer line extensions.

When new sewer systems are installed, they should be sized for planned 15 to 20 years of growth.

Expected Reduction: 100% nutrient reduction from elimination of the septic systems due to wastewater being treated in a different watershed (Murderkill).

RECOMMENDATIONS SPECIFIC TO TAX DITCHES

12. Installation and maintenance of sediment traps – institute studies to determine effectiveness of tax ditches in removing nutrients.

Sediment traps are effective at sediment control in tax ditches. The studies will evaluate the effectiveness of sediment traps in removing nutrients from the water flowing from tax ditches to the Chester and Choptank Rivers.

Expected Reduction: A reduction value cannot be assigned to this recommendation; the studies themselves do not have a direct reduction.

13. The State or County should provide the funding to install and maintain sediment traps.

This recommendation should be implemented if the results of the studies undertaken in recommendation 12 show that sediment traps are an effective nutrient reduction tool. Selection of locations for sediment traps should be at the discretion of the tax ditch organizations based on engineer recommendations. The State or County should, in addition, cover the additional costs for dipouts and mowing.

Expected Reduction: A reduction value cannot be assigned to this recommendation until the studies are completed.

14. Notify and include Tax Ditch organizations in decision making processes on land adjacent to the tax ditch.

The State, New Castle and Kent County need to recognize the local authority of each tax ditch incorporated entity and involve them in decisions affecting tax ditch management and the right-of-ways. This can be accomplished effectively through linking the tax ditch organizations into the Preliminary Land Use Service (PLUS) process. The PLUS process involves reviews by all applicable state agencies at the start of the land development process, adding value and knowledge to the process. Land use change proposals are submitted to state agencies through the Office of State Planning Coordination and are the subject of monthly PLUS meetings, at which applicants meet with state agency resource experts to discuss their plans and identify possible problems, and solutions. The tax ditch organizations should be included in the review process along with the state agencies.

Expected Reduction: A reduction value cannot be assigned to this recommendation.

15. Require property owner to install fencing for animals outside of the tax ditch right-of-way

Require adjacent property owners to install suitable permanent structures to act as a barrier between pasture land and ditches, with the purpose of excluding livestock from the ditch, reducing both nutrient and bacteria loadings to the water.

Expected Reduction: Fencing of animals to keep them out of waterways is estimated to produce a reduction of 25% for Nitrogen and 40% for Phosphorus.

16. Provide data on the non-point impact that septic disposal systems have on the water quality in adjacent tax ditches.

As land use changes continue to evolve within the Upper Chesapeake Watershed, water quality within the existing tax ditch waterway systems will continue to be impacted. Increasing the number and frequency of water quality monitoring sites now will provide additional base line data that will be useful in aiding the future decision making process for all stakeholders.

Expected Reduction: A reduction value cannot be assigned to this recommendation.

<u>RECOMMENDATIONS PROVIDING INCENTIVES FOR ADDITIONAL AGRICULTURAL PRACTICES</u>

Note – Recommendations 16-18 are highest priority of the agricultural recommendations

17. Increase the funding for cost shares to allow an increase in the number of acres that can be planted in cover crops.

Cover crops are planted to provide protection to soils when row crops are not being grown. Some are effective at scavenging Nitrogen and slowly releasing it back to the soil so that the next row crop can utilize it. Currently, the number of acres that can be covered by cost share is limited by the funding available. The funding should be increased so that if a farmer wants to plant a cover crop, they should be able to receive cost share. Allow the cover crop to be cut for sale to facilitate removal of the nutrients from the watershed. The use of fertilizer on cover crops should be examined as long as it results in a net reduction in nutrients.

Expected Reduction: Nitrogen ~59%, but varies depending on species used; Phosphorous 4.9%

18. Increase awareness of availability of cost share for water control structures.

Water control structures are devices that convey water, control the direction or rate of flow, and maintain a desired water surface elevation. They are typically used to control the depth and discharge of water in open channels, ponds, and wetlands. Water control structures are also useful in reducing nitrogen, therefore, more information regarding the availability of cost share for water control structures should be made available to relevant property owners.

It should be noted that, in designing and installing water control structures, care needs to be taken to ensure that there are no adverse impacts on upstream farms. In addition, water control structures need to be properly maintained in order to remain effective.

Expected Reduction: Nitrogen 33%

19. Manure sheds:

- ***a. Increase the allowable manure shed size.***
- ***b. Increase the amount of cost share available for manure sheds.***

Currently, the amount of cost share only allows for sheds that are sized for poultry house crust outs; the cost share should be increased to allow for sheds large enough to handle poultry house cleanouts.

Expected Reduction: Although there will be nutrient reductions from this action, there is currently no information regarding the load reductions from this activity.

20. Increase the cost share for grassed filter strips and allow the grass to be cut for hay.

Grassed filter strips are areas of vegetation between cropland and other land uses such as grazing land, disturbed lands, forests, pasture and environmentally sensitive areas. They are designed to trap sediments in surface runoff and take up excess nutrients. Increasing the number of grassed filter strips is advantageous, and increasing the cost share would provide incentives to create more strips. Similarly, allowing the grass to be cut for hay increases incentives for grassed filter strips.

In addition, switch grass can be considered for growth in the filter strips and then harvested as an energy crop.

Expected Reduction: Bacteria 43-57%; Nitrogen 46%, and Phosphorus 54%

21. Increase the cost share for grassed waterways and allow the grass to be cut for hay.

Grassed waterways are natural or constructed swales, shaped or graded, and established in vegetation for safe conveyance of runoff. They transport surface runoff away from cropland without causing erosion or flooding and protect and improve water quality. Increasing the cost share and allowing the grass to be cut for hay would provide more incentives to create grassed waterways.

In addition, switch grass can be considered for growth in the grassed waterways and then harvested as an energy crop.

Expected Reduction: Bacteria 43-57%; Nitrogen 46%, and Phosphorus 54%

22. Increase the cost share to encourage an increase in the number of acres enrolled in CREP for Grassed Waterways and Grassed Buffers

Grassed waterways and Grassed buffers are areas of vegetation between water and cropland, grazing land, or disturbed lands, including forestland and environmentally sensitive areas. They are designed to trap sediments in surface runoff and utilize excess nutrients. They reduce nutrient losses from upland acres and sediment bound P from entering waterways. In addition, there are some habitat benefits.

In addition, switch grass can be considered for growth in the filter strips and then harvested as an energy crop.

Expected Reduction: Nitrogen 46%, Phosphorus 54%, Bacteria 43-57%, in addition to the change from cropland to grassland.

EDUCATION RECOMMENDATIONS

23. Conduct tax ditch right-of-way education

Provide residents with educational information, including signage, on what the tax ditch right of way is, its purpose, and what is and is not allowed to be done in the right of way. For example, that 4-wheelers and horses are not allowed in the right of way. In addition, the education should encourage best management practices regarding tax ditches for residents of the watersheds; these include such things as not dumping grass clippings in ditch.

Expected Reduction: A reduction value cannot be assigned to this recommendation.

24. Develop and implement a comprehensive homeowner education program for management of open spaces, yards, wastewater and stormwater.

Changes in homeowner behavior resulting from effective education efforts can result in a reduction in the amount of nutrients ending up in the Chester and Choptank Rivers. Education should include things such as the following:

- Identification of values which are affecting residential activities and target those that will effect behavior change.
- Education regarding the use of soil tests to the urban/suburban homeowner.
    - Work with the University of Delaware to revise their soil test results sheet for homeowners to make it easier to be understood and provide specific fertilizer application recommendations based upon existing fertilizer blends found within the State.
- Education regarding the negative impact of garbage disposals on septic systems.
- Educating homeowners and homeowner associations on storm water BMPs that can be used around the home to reduce impact on water quality.
- Integrating education into various (state and local) permitting processes and public information campaigns should be based upon goal of behavior change.
- Water conservation measures, such as the ones listed below, to help reduce the amount of nutrients leaving individual properties.

  - o Rain collection systems such as rain barrels and rain gardens,
  - o Directing stormwater runoff from roofs and impervious surfaces onto grassy areas,
  - o The use of water saving devices in and around the home, in addition to
  - o The overall reduction of water usage in households and on lawns
- ✦ In conjunction with the Delaware Nutrient Management Commission and the Master Gardeners, provide education and programs for homeowner's on lawn and garden best management practices., such as:
  - o Proper mowing practices,
  - o Leaving lawn clippings on the lawn;
  - o Encourage proper lawn care maintenance-leave a buffer along stream edge;
  - o Water conservation measures and stormwater BMPs for the lawn and garden;
  - o Encourage use of native species and noninvasive species;
  - o Discourage ideas that lawns need chemicals to be green;
  - o Proper use of lawn and garden chemicals (including natural fertilizers and compost)
  - o Use of compost rather than chemicals as a means of reducing synthetic chemical fertilizers.
  - o Smartyard program for homeowners
  - o A demonstration project/workshop for homeowners on application of fertilizers and composting methods

Expected Reduction: A precise reduction value cannot be assigned to this recommendation

Recommendation Summary

	Nitrogen Load Reduction (lbs/day)	Phosphorus Load Reduction (lbs/day)
1. Identify areas where stormwater retrofits would effectively reduce sediment and nutrients	Up to 70%	Up to 65%
2. DNREC and the New Castle and Kent County Conservation Districts should educate Home Owners' Associations (HOAs) regarding the Stormwater BMP maintenance and management requirements and enforce these requirements.	Help ensure reductions associated with specific BMP	Help ensure reductions associated with specific BMP
3. Onsite Wastewater Treatment and Disposal Systems: a. Promote biennial pump outs of individual onsite wastewater treatment and disposal systems. b. Require pump out contractors to report failed onsite wastewater treatment and disposal systems to the Department of Natural Resources and Environmental Control.	200% increase over 3-year pump-out	112% increase over 3-year pump-out
4. Require stores to require a soil test for fertilizer purchases or ban phosphorus in residential fertilizer sold in Delaware.	Currently No Info	Currently No Info
5. Enact legislation to ban the sale of detergents and soaps containing phosphates.	Currently No Info	Currently No Info
6. Require stormwater BMPs be designed to be "Green Technology BMPs" to reduce nutrients according to TMDLs; stormwater structures would be designed to reduce sediment, nutrients, and bacteria and would allow more infiltration, rather than water retention and detention.	Up to 70%	Up to 65%
7. Require Low Impact Development (LID) in new construction and development.	Currently No Info	Currently No Info
8. a. For new septic systems, if the system fails due to design, the organization designing the regulations for the system should be responsible for system replacement. b. Provide "pilot/demonstration project" funding for new and proven on site waste-water systems, including RBD units, to replace failing septic systems.	No additional loadings	No additional loadings
9. When change from agriculture to developed land, require vegetated buffers of adequate and proper widths sufficient to reduce or eliminate nonpoint source pollution for lots abutting waters in the watersheds, with a recommendation being 20 feet beyond the end of the Right-of-Way.	2.5 to 70% depending on type and amount of existing vegetative cover	3.6 to 66% depending on type and amount of existing vegetative cover
10. Require a Nutrient Management Plan for any open space within a development.	10-15%	10-15%
11. Prioritize areas where failing individual, large, and community wastewater treatment and disposal systems can be eliminated by connecting to the Kent County Waste Water Treatment Plant.	100%	100%
12. Installation and maintenance of sediment traps – institute studies to determine effectiveness of tax ditches in removing nutrients.	Studies needed	Studies needed
13. The State or County should provide the funding to install and maintain sediment traps.	Studies needed	Studies needed
14. Notify and include Tax Ditch organizations in decision making processes on land adjacent to the tax ditch.	N/A	N/A
15. Require property owner to install fencing for animals outside of the tax ditch right-of-way.	25%	40%
16. Provide data on the non-point impact that septic disposal	N/A	N/A

systems have on the water quality in adjacent tax ditches.		
17. Increase the funding for cost shares to allow an increase in the number of acres that can be planted in cover crops.	~59%	4.9%
18. Increase awareness of availability of cost share for water control structures.	33%	
19. Manure sheds: a. Increase manure shed size. b. Increase cost share available for manure sheds.	Currently No Info	Currently No Info
20. Increase the cost share for grassed filter strips and allow the grass to be cut for hay.[4]	46%	54%
21. Increase the cost share for grassed waterways and allow the grass to be cut for hay.[5]	46%	54%
22. Increase the cost share to encourage in increase in the number of acres enrolled in CREP for Grassed Waterways and Grassed Buffers.[6]	46%	54%
23. Conduct tax ditch right-of-way education.	N/A	N/A
24. Develop and implement a comprehensive homeowner education program for management of open spaces, yards, wastewater and stormwater.	N/A	N/A

[4] Bacteria reduction of 43-57%.
[5] Bacteria reduction of 43-57%.
[6] Bacteria reduction of 43-57%.

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